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PROGRESS REPORT

of the

FARM PRODUCTION ECONOMICS DIVISION

ECONOMIC RESEARCH SERVICE

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CURRENT SERIAL RECORDS

This progress report includes a summary of the current research of the Division and a preliminary report of progress made during the preceding year. It is primarily a tool for use of scientists and administrators in program coordination, development and evaluation; and for use of advisory committees in program review and development of recommendations for future research programs.

The summaries of progress on USDA and cooperative research include some tentative results that have not been tested sufficiently to justify general release. Such findings, when adequately confirmed, will be released promptly through established channels. Because of this, the report is not intended for publication and should not be referred to in literature citations. Copies are distributed only to members of Department staff, advisory committee members and others having a special interest in the development of public agricultural research programs.

This report also includes a list of publications reporting results of USDA and cooperative research issued between July 1, 1967, and June 30, 1968. Current agricultural research findings are also published in the ERS publications The Farm Index, a monthly, and Agricultural Economics Research, a quarterly. This progress report was compiled in the Farm Production Economics Division, Economic Research Service, U. S. Department of Agriculture, Washington, D. C.

UNITED STATES DEPARTMENT OF AGRICULTURE

Washington, D. C.

July 1, 1968

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INTRODUCTION

Farm production economics research, as used in this report, deals with many and varied economic problems of agricultural production. The work is concerned with the economics of organization and management of farms and the agricultural supply industry, use of capital and labor in agriculture, adjustments in production and resource use, and appraisal of alternative production policies and programs. First priority attention is given to those problems with nationwide, regionwide, commodity-wide or resource-wide implications.

A continuing major problem in agriculture is the adjustment of production, both in the aggregate and for major commodities, to market outlets. Achievement of economic balance in agriculture and adequate returns to farmers is likely to continue to be difficult over the next 5 to 10 years as we strive to match the increasing capacity of agriculture to produce with the food and fiber requirements of a larger U. S. population and expanding outlets for exports and Food for Freedom programs. Farms are decreasing in number and increasing in size and degree of specialization. Farm machinery, fertilizers, and other innovations, are substituting for land and labor. Coupled with rising farmland values, these developments necessitate large and increasing capital investments per farm, and alter farm credit and insurance needs. Increasing dependence on purchased inputs and on cash markets for products make net income increasingly vulnerable to changes in prices of both inputs and outputs. These trends together with emerging problems in farm labor challenge the most rigorous research in the field of farm economics. Results of research in this field are widely used as aids in management and policy decisions at the farm, area, regional, State, and national levels.

The Department's program of research and related statistical reporting in farm production economics is conducted from headquarters in Washington, D. C., and is concerned chiefly with problems of regional and national scope. Field studies generally are conducted in cooperation with State experiment stations. When studies are made jointly by Federal and State workers, Federal people usually are most interested in regional and national applications of results, while State workers are most often interested in local applications. Close working relationships between Federal and State agencies have long been traditional in this field. This close cooperation in planning and conducting the work reflects joint and cooperative efforts rather than overlapping or duplication of effort.

This year, pursuant to a new directive, the farm production economics research program is covered under the five Research Problems Areas ("RPA's")

into which the Division's research projects have been classified in "A National Program of Research for Agriculture" and the Department's Current Research Information System ("CRIS"). These new main headings are shown in the Table of Contents. More detailed subject-matter subheadings are given in the discussion of the work done under each RPA. This report is for Fiscal Year 1968 (July 1, 1967 - June 30, 1968), whereas preceding annual reports were for the 12-month period ended Oct. 1.

Cropland Retirement Program Analyzed. In exploring ways of restricting production to market demands at satisfactory prices, an analysis was made of the probable effects of a general land retirement program. Minimum costs of retiring the 50 million acres of cropland with lowest per acre returns above variable costs would be about \$700 million annually, plus administrative costs. The cost of retiring 70 million acres would be \$1.2 billion. Thus, a 40-percent increase in acreage retired would raise minimum program costs by 70 percent. The analysis assumed that diversion of cropland in any one county would not exceed 30 percent of the total cropland in that county. With this restriction and a 50 million acre program, acreage retired would range from 26 percent of the cropland in the Great Plains to 9 percent in the Corn Belt. With 70 million acres retired, retirement outside the Great Plains would increase substantially.

Production potential would be very large even after retirement of 70 million acres. The remaining acreage, assuming no development of new land and assuming 1967 normal yields, would have the aggregate capacity to produce 171 million tons of feed grains, 1.1 billion bushels of soybeans, 900 million bushels of wheat, and 16.3 million bales of cotton. Considerable potential exists for development of new land particularly if 1967 prices are maintained as assumed in the analysis, thus posing a real threat to the success of a general cropland retirement program unless some restrictions were imposed on the use of the remaining land.

Farming Operations by Corporations Surveyed. A survey was made in 1968 to identify those corporations engaged in agricultural production. This inventory type survey showed that corporations made up less than one percent of the total number of commercial farms in the first 22 States covered, operated about 7 percent of the land, and accounted for an estimated 4 percent of the total sales of farm products. More than 70 percent of the corporations found were family businesses, most of which were family farms that had incorporated to facilitate transfer to surviving family members. About one-third of the corporations had one or more business activities in addition to their agricultural operations. In the Midwest, such activities frequently involved the manufacture or sale of feed, fertilizer and farm machinery, or the processing and marketing of farm products. The business interests of about an equal number of farming corporations were not related to farm supplies or marketing.

About 40 percent of the corporations had gross sales of less than \$40,000, but nearly one-third had sales of \$100,000 or more, and 6 percent had sales of \$500,000 or more. More than half of these largest sales of \$500,000 or more incorporated farm businesses were family owned. Nearly one-half (45 percent) of all corporations identified in the survey were organized prior to 1960 and about an equal proportion in 1960-66. The proportion organized in 1967 and the first two months of 1968 was about 8 percent. Survey results for the remaining 26 conterminous States are in process. They include the States of California, Florida and Texas, known to have a substantial number of corporations engaged in farm production.

Off-Farm Income Augments Farm Income for Many. Individuals--including farm operators, farm landlords, and informal farm partners--still dominate the farm economy. They accounted for nearly 96 percent of more than 3 million 1965 farm tax returns, and reported more than three-fourths of the \$39 billion in farm receipts. Partnerships accounted for fewer than 4 percent of the tax returns but reported 10 percent of the receipts. These and related findings are derived from a detailed study of anonymous income statistics published by the Internal Revenue Service.

Analysis of the more detailed statistics published for 1963 showed that most individuals with farm income receive some off-farm income and many receive most of their income from off-farm sources. In 1963, individuals with farm income reported off-farm income of \$10.9 billion and capital gains of \$1.2 billion. Wages and salaries totaling \$7.1 billion were the most important off-farm source. Dividends and interest totaled \$1.5 billion. Nonfarm business income was also nearly \$1.5 billion. Other miscellaneous sources such as rents, royalties, pensions and annuities amounted to \$0.8 billion.

In 1963, two-thirds of the individual farm tax returns showed profits. For those with farm profits, additional income from off-farm sources averaged \$2,120 per individual and accounted for about half of their total income. For those reporting losses, nonfarm income averaged \$7,018. Off-farm income and capital gains were more important than farm profits for more than one-third of those reporting profits. One-fifth of those with farm profits reported that 80 percent or more of their combined income came from off-farm sources and capital gains. Off-farm income averaged more for those with the largest farm profits but accounted for a greater share of combined income for individuals with small profits.

Among those with losses, the greater the reported farm loss the larger the average income from all sources combined and, apparently, the less likely that the individual made his living by farming. Those with farm losses averaged \$5,278 from combined farm and off-farm sources compared with \$4,340 reported by individuals with profits. Thus, it is increasingly the

case that profits and losses from farming alone are inadequate indicators of the income situation of individuals engaged in farming.

Large-Scale Farms Accounted for a Fourth of Total Sales in 1964. Detailed analysis of recently tabulated census data show that the number of farms with gross sales of \$100,000 or more (referred to here as large-scale farms) increased from about 20,000 in 1959 to more than 31,000 in 1964. Such farms were concentrated chiefly in the Pacific, Mountain, and Southern Plains regions. California accounted for 23 percent of the total number of all large-scale farms and for 29 percent of the total sales of this group. Arizona and Florida also had substantial numbers of large-scale farms. In the Lake States and Corn Belt, large farms accounted for only 5 percent of all farms and for less than 10 percent of all farm sales.

With respect to commodities sold, 61 percent of the total sales of vegetables and 46 percent of the total sales of fruits and nuts came from large-scale farms in 1964, compared with less than 5 percent for tobacco, corn and oats. Large-scale farms accounted for about one-third of total sales of cattle and calves, but less than 5 percent of the sales of hogs and pigs.

The operators of nearly half (46 percent) of all large-scale farms were classified as part owners in 1964, and 30 percent were full owners. These proportions were about the same as in 1959. Hired managers operated 12 percent of this group of farms and most hired managers were probably on corporation-owned farm units.

Wheat production Potential is Large. Budget analysis of representative farms in 11 Great Plains and Pacific Northwest States provided estimates of wheat production at a variety of assumed wheat, feed grain, and live-stock prices. The area studied produced 98 percent of the hard winter wheat, 89 percent of the hard spring wheat, 96 percent of the durum, and 89 percent of the western white wheat in 1964. Under assumptions of no production control programs, a corn price of \$1.07 per bushel, and a wheat price of \$1.75 per bushel (all prices at Kansas City), potential production of these four classes of wheat of over 1,800 million bushels would be 189 percent of the 1964 production level (962 million bushels). Under the same conditions, a wheat price of \$1.25 per bushel would be likely to result in production nearly equal to the 1964 level; at \$1.00 per bushel, only about one-third of this level.

The bulk of the reduction in wheat production at the \$1 price level would occur in the winter wheat areas in the Southern Plains with the land being shifted to feed grain production. Thus feed grain production in the Southern Plains would increase more than threefold. In the spring wheat areas, some reduction in wheat would be accompanied by increases in feed

grains, flax and forage. Hence, at the lower wheat prices, hard spring and western white wheat production would constitute a larger percentage of the total output than at present, or at the higher wheat price levels. The potential supply of all wheat was found to be highly elastic at low wheat prices, but became less elastic as wheat prices increased. The supply of hard spring and western white wheat was estimated to be most elastic between \$1.00 and \$1.25 per bushel, while for hard winter wheat, supply was most elastic between \$1.25 and \$1.50 per bushel. Variations in the level of feed grain prices were shown to have most effect on the production of hard winter wheat, and least effect on hard spring and durum wheat production. This would be expected to occur because of better opportunities for feed grain production in most of the winter wheat areas.

Research Program Appraised. During the year, a comprehensive appraisal was made of current research and future needs in the Division's program covering the two fields of agricultural finance, and costs and returns for major farm types in the United States. Statements were prepared to guide the development of the Division's future research program in both of these important subject-matter areas.

A much increased capital intensity of farming is occurring as farmers take actions to utilize the new production technology which is available, to operate production units of expanded size, and to substitute capital for the labor resources which have rapidly moved out of farming. The growing separation of use and ownership of production resources has substantial implications for the financial structure of agriculture. Farm operators are increasingly acquiring access to the services of land, machinery and even livestock through renting; leasing custom services; vertical integration; and even through special legal entities designed to encourage the flow of investment capital into farming. Moreover, most farm people now have nonfarm sources of income, and a number of individuals and firms are engaging in farming primarily for "tax loss purposes." As a consequence of these new sources of capital and new incentives for farming, the financial structure of farming has become extremely complex.

Plans have been made for a substantial research program in agricultural finance including the following four sub-areas: (1) Farm firm finance, including financial management; (2) the financial structure and organization of the farm production sector; (3) the supply, demand, and markets for farm capital, including credit; and (4) the income structure of the farm sector and the financial status of farmers.

Appraisal of the Division's costs and returns research program indicated that these series have provided a much used and continuing source of information on major farm types in the U. S., but that it could, with some

changes, be made an even more vital source of economic intelligence. Among the plans for future changes are: (1) A reduction in the number of series to about half of the current 42; (2) a shift to depiction of units of viable size and organization only; (3) the provision of statistical information to indicate the incidence of each of the farm types represented within the distribution of the total population of farms, and their respective contributions to regional or commodity production; (4) the provision of a financial balance sheet for each farm type; (5) computation of comparative (with nonfarm investment and employment alternatives) resource returns, both with and without capital gains; and (6) depiction on a 5-year basis of changes in tenure, business organization, and off-farm income on each farm type.

These modifications in the costs and returns analyses will be implemented for some farm types for the 1968 production year and for others a year later.

SYSTEMS ANALYSIS IN PRODUCTION OF FIELD CROPS
(RPA 309)

USDA and Cooperative Program

Location of Intramural Work	Subject	Scientist
		Man-years FY 1968
Georgia	Cotton costs	1.0
Louisiana	Cotton costs	0.6
South Carolina	Cotton costs	2.0
Tennessee	Cotton costs	1.0
Washington, D. C.	Cotton costs	2.7
Washington, D. C.	Fertilizer use	0.8
Total		8.1

Intramural program is supplemented by extramural support representing 0.2 SMY's at California Agricultural Experiment Station.

Problems and Objectives

Farm operators must often choose among crops, crop sequences, and methods or "systems" used in the production of each crop including machinery and equipment, fertilizer and other practices, and improved technology. By determining and evaluating the profitability of alternative crop production plans or systems and components thereof, economic analysis aids in selection of the most profitable production plan among available alternatives.

Research on cotton costs is conducted to fulfill the provision in the Agricultural Act of 1964 that the Secretary of Agriculture should consider, among other factors, the cost of production in setting price support levels for cotton, and to aid in developing ways and means for reducing production costs.

In the research projects currently being conducted by the Division under this RPA, the major objectives are to:

1. Annually estimate the cost of producing cotton in the U. S.
2. Analyze and evaluate methods for reducing the cost of producing cotton.
3. Estimate the use of fertilizer in the U. S.
4. Estimate crop yield response to fertilizer and project economic potentials for fertilizer use and crop yields.

Progress - USDA and Cooperative Program

A. Cotton Cost Analysis

1. Results from a beltwide enumerative survey indicate that the total cost of producing the U. S. crop of upland cotton in 1965 was 27.3 cents per pound of lint, compared with 28.4 cents in 1964. About 73 percent of U. S. cotton was produced at a total cost of less than 30 cents per pound in 1965. Estimates of total cost per pound of lint in 1965 ranged from 24.7 cents in the Mississippi Delta region to 34.9 cents in the Upper Rio Grande-Trans Pecos region of Texas and New Mexico. Total costs per pound of lint in 5 regions averaged less than 26 cents. These regions were the Mississippi Delta, Southern California and Southwest Arizona, the Coastal Prairie of Texas, the High Plains of Texas, and the Rolling Plains of Texas-Oklahoma. The first three regions listed above were among the four lowest-cost regions in 1964.

2. Progress has been made in several southern areas in evaluating the effects of alternative practices on costs of producing cotton. In Tennessee, data obtained from a selected group of innovators showed that their average production cost per pound of lint in 1966 was 15.46 cents per pound compared with 15.51 cents in 1965. Production costs on these farms are substantially

lower than the regional average costs, indicating a good potential for cost reduction.

3. In South Carolina, the development of enterprise budgets and related materials has been completed and published. Thirty-six alternative cotton production systems, which comprise variations in the basic equipment complement and use of specialized machines, were evaluated. Returns to land, management, and overhead under these alternatives for cotton ranged from a low of \$122 per acre to a high of \$244 per acre. Programming matrices based on these data were employed in analyzing the effects of different levels of technology, and the combined effects of variations in technology and in Government programs on farm income and organization. The analysis indicated that diversion of allotments was a profitable alternative. Thirty-five percent of the available allotment was diverted with a diversion payment as low as \$.05 per pound.

4. In Georgia, a study of progressive cotton farms in the Coastal Plains area indicates substantial opportunities for reducing costs of producing cotton. Budgetary analysis based on data from surveys in 1965 and 1966 was used to evaluate cost-reducing alternatives and to establish least-cost production practices and combinations of practices. Cost reductions attributed to the use of the least-cost practices over the various other alternatives ranged up to about \$35 per acre of cotton. Direct costs of production (costs excluding land and overhead) on farms in the select sample were about 6 cents per pound lower than costs on a random sample of area farms included in the beltwide enumerative survey of cotton costs.

5. The treatment of land costs in estimating cost of production is a difficult problem. Special studies of land values in selected cotton-producing areas have been undertaken to assist in the solution of this problem.

Analysis of land sales data in the Imperial Valley of California is nearing completion. Analysis in this area, where cotton is an important crop, indicates that, based on capitalized values obtained from calculated returns to land, a farming operation of less than 575 acres could not have purchased land at the average market price of \$600 if it desired a 6-percent return on investment. Similarly, an operation having less than 950 acres could not have purchased land at that price if an 8-percent return were specified. No operation could have purchased land if a 10-percent return was the desired goal. In general, the farming of rental land is profitable at prevailing cash rents in the area, whereas the relative profitability of land ownership must be analyzed in terms of farm size and stated returns on investment.

6. A final report on land values in the Mississippi River Delta cotton region was published. Wide variability was found in prices paid for land during 1964-65 in 17 Delta counties and parishes. Prevailing average prices paid for various classes of land were \$231 per acre for open land, \$85 per acre for woodland, and \$316 per acre for cotton allotment. Much of the variation in land prices was not explained by the variables included in a

multiple regression model. Nonmeasurable factors such as intensity of desire on the part of buyers, lack of knowledge on the part of buyers and sellers, and qualitative decisions such as topography, drainage, and estimated productivity also contributed to the variability in sales price.

B. Fertilizer Use and Yield Response

1. Work was completed and published on the estimated use of fertilizer in the U. S. by crops and areas in 1964. These comprehensive estimates, by crops, are presented by States and parts of subregions, by whole subregions, and by major regions. Trends are indicated by comparisons of fertilizer used in past years.

2. Work was completed and published on crop yield response to fertilizer in the U. S. These comprehensive estimates, by major crops, are presented by State parts of agricultural subregions. The report presents new fertilizer response curves which show significant changes from earlier curves both in level and shape.

3. Several State reports on fertilizer use were published. They were based on the data obtained for the national report described in 1 above.

Publications - USDA and Cooperative Program

A. Cotton Cost Analysis

Butler, C. P. and Robinson, B. H. 1967. Machinery costs on South Carolina farms. S. C. Agr. Expt. Sta. AE 309. 21 pp.

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Penn, J. B., Bolton, B., and Woolf, W. F. 1968. The farm land market in the Mississippi River Delta cotton region, 1964-65. La. Agr. Expt. Sta. D.A.E. Res. Rpt. No. 372. 68 pp.

Robinson, B. H. 1968. A programming model for analyzing the effects of changing technology and government programs on farm organization and income. Speech: South Carolina Academy of Science, Columbia, S. C., April 27, 1968. 12 pp.

Robinson, B. H. and Butler, C. P. 1968. Requirements for and costs of producing cotton and competing crops with alternative techniques, Upper Coastal Plain. S. C. Agr. Expt. Sta. AE 312. 153 pp.

Starbird, I. R. and French, B. L. 1967. Costs of producing upland cotton in the United States, 1964. 1965 Supplement to Agr. Econ. Rpt. 99. 34 pp.

B. Fertilizer Use and Yield Response

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Elder, William A., and Van Arsdall, Roy. Principal plant nutrients used on crops and pasture in Illinois, 1964 estimates and selected comparisons with 1954 and 1959 estimates. 1967. Ill. Agr. Expt. Sta. AERR-86. 31 pp.

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Ibach, D. B. and Adams, J. R. 1967. Fertilizer use in the United States. Statis. Bul. No. 408. 384 pp.

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Quance, C. L., and Tucker, Billy B. 1967. Fertilizer use in Oklahoma. Oklahoma Current Farm Economics, 40(3), pp. 74-79.

Schaffner, L. W. and Voelker, S. W. Statistics on fertilizer consumption in North Dakota, 1951 and 1966. 1967. N. Dak. Agr. Expt. Sta., Agr. Econ. Rpt. No. 53. 47 pp.

Sharples, Jerry A. and Perrin, Richard. Fertilizer use in Iowa reaches record levels. 1967. Iowa Farm Science 22(2), pp. 7-8.

Sitler, Harry G., Steward, William G., Heil, Robert D., Viets, Frank G., Jr. and Schmehl, W. R. 1967. 1964 fertilizer use for principal crops in Colorado with comparisons. Coop. Ext. Serv., Colo. State Univ. Unnumbered. Mimeographed. 30 pp.

IMPROVED LIVESTOCK AND POULTRY PRODUCTION
MANAGEMENT SYSTEMS
(RPA 313)

USDA and Cooperative Program

Location of Intramural Work	Subject	Scientist
		Man-years FY 1968
Arizona	Feed-livestock adjustments	1.0
Colorado	" " "	0.5
Nebraska	" " "	1.0
Oregon	" " "	1.0
Indiana	" " "	2.0
Georgia	" " "	0.3
Washington, D. C.	Feed use	0.6
Minnesota	Dairy adjustments	1.0
Wisconsin	" "	1.0
Maine	" "	0.5
New Hampshire	" "	1.0
New York	" "	1.0
Pennsylvania	" "	2.0
California	Range-livestock adjustments	2.0
Colorado	" " "	0.5
Montana	" " "	1.0
Oregon	" " "	0.6
Texas	" " "	1.0
Washington, D. C.	Poultry	0.5
Total		18.5

Intramural program is supplemented by extramural support representing 0.5 SMY's at the University of Nebraska.

Problems and Objectives

Profitable livestock and poultry operations involve the efficient use of land, labor, feed, equipment, capital, and the animals themselves in a production plan or system. Economic analysis provides the basis for choosing between alternative ways and means, methods, practices, and production plans, and new or improved technology, and for making timely adjustments in response to changing prices, costs, and technology.

Major objectives of the research are to:

1. Determine and appraise the need for, profitability of, and obstacles to, adjustments in livestock and poultry production including the probable aggregate impact of individual farm adjustments on market supply and price.
2. Formulate and evaluate improved livestock and poultry plans or systems.

Progress - USDA and Cooperative Program

A. Appraisal of Adjustments in Feed-Livestock Areas

1. Research on the cooperative regional study of adjustments in hog and beef cattle production (Regional Research Project NC-54) has been completed. Results were reported in two publications. Continuing work at Iowa and Indiana centers on use of State models to estimate supply functions for hogs and fed beef. These efforts utilize State models which allow consideration of inter-firm competition for labor, feed, feeder cattle, and other inputs. Budgets are being developed to represent an average level of technology for 1970.
2. An economic appraisal of the cattle feeding industry in the United States is underway with major activity at Illinois, Nebraska, Colorado, Arizona, South Carolina and Oregon. At each of these locations, materials describing the beef cow and cattle feeding operations are being developed. In the southern region a regional research project (S-67 "Evaluation of the Beef Production Industry in the South") was established. The Regional Technical Committee is developing a survey to obtain information on resources and management systems used in beef production in the South. At South Carolina an analysis was made of six beef feeding systems. Results showed negative returns under the management practices used. Beef feeding systems in west-central Illinois were found to be insensitive to minor changes in production costs or product prices. Small-scale supplementary feeding enterprises will probably continue on many farms because of the fixed investments in buildings and equipment. Large-sized efficient operations which can compete with production of hogs and crops will also continue to be found. On the other hand, medium-sized feeder enterprises, which are too large to be strictly

supplementary and too small to use efficient production systems, are likely to disappear in the area. In Arizona, two Master's theses were completed dealing with the factors affecting feed intake, average daily gains, and feed conversion rates in cattle feeding in Arizona. At Colorado a survey of feedlots with less than 500 head capacity is underway. The survey is designed to determine the profitability, competitive position, and management problems of the farm feedlot.

In Nebraska a study is underway of the various alternatives in selling of fat cattle. Terminal auction markets, nonterminal markets, terminal-private treaty markets, and direct selling methods are being examined from the standpoint of adequacy, equity, and efficiency of marketing. Also at Nebraska, quantitative determination of demand relationships is in progress. Relationships at the retail demand level have been found to be fairly clear and discernible. However, demand relationships at the farm level, between fat cattle and feeder cattle or feed, are weak and distorted.

In Oregon a simulation model of the fed-beef sector of the economy is being developed. Also, a survey of the characteristics of feedlot firms and cost characteristics is underway. In Georgia a manuscript has been prepared dealing with the costs, returns, and resource use over time on beef cattle farm units in the Piedmont areas.

3. Continuing research at the national level aims to measure effects of existing and new technology on feeding efficiency in livestock production and associated supply industries. Annual data on current feeding rates for all kinds and classes of livestock are developed. Significant trends in the feed-livestock industry are identified. Animal units and feed units series are related to total production of feeds and livestock.

In addition to revising previous years and adding a new year of data to the animal unit and livestock production unit series, new work consisted of changing the base period for these series from 1940-45 to 1959-61. For the grain-consuming animal unit series, the base period change resulted in a reduction in number of animal units in 1967-68 from 178.2 million to 111.1 million. Most of this reduction is due to the greatly increased amount of concentrates fed to milk cows in the 1959-61 period compared to the 1940-45 period, thus increasing the size of the animal unit in terms of feed consumption.

As a part of this project, the requirements for total digestible nutrients for the livestock inventory for 1959-60 has been recalculated. This had previously been done for the year 1949-50. This new calculation indicates that, compared to harvested feed consumption, pasture and grazing lands are producing a smaller proportion of the total feed for livestock than 10 years earlier.

4. A major study of consumption of urea by beef cattle and milk cows represents the first phase of an analysis of the effect of emerging innovations

in the feed-livestock industry. A report concerning the consumption of urea by cattle on feed has been completed and submitted for publication. This analysis indicates that cattle on feed in the United States during the 1965-66 feeding year consumed about 327 million pounds of synthetic urea. About 31 percent of all operating feedlots and 58 percent of the cattle on feed April 1, 1966 were using urea. This included three-fourths of all feedlots with more than 300 head on feed.

5. Development of methodology to improve formula feed estimates by States on an annual basis was the subject of a special study. The project was initiated and largely completed during the year. Recommendations (preliminary) include a national survey of feed manufacturing plants to determine capacity and other pertinent characteristics, and an annual computation of consumption of formula feeds by class of livestock and kind of feed.

6. The general objective of a contract research project initiated during the year with the University of Nebraska is to provide analyses and recommendations to improve the overall level of economic intelligence, and to serve as a basis for improved decision-making, in the feed-livestock sector. Special emphasis is directed to analyses and procedural methods which will improve industrywide performance in producing and marketing cattle and hogs. Research attention is being given both to (a) aggregate industry performance and (b) the performance of individual firm decision-makers in the system.

Initial analysis has been completed determining key value relationships between market levels and animal forms (grade, weight, location). These relationships have been found to reflect strong competitive values so that the effects of improved order in the system can yield substantial industry-wide payoff. Relationships between slaughter cattle and feeder cattle, time points for most animal forms, were weak and distorted. This indicates that the critical economic deficiencies in the livestock sector are found to be disorderly production and marketing levels over time and between animal classes.

Descriptive categories of livestock are being delineated. These include form (sex and weight classes) and time (annual, quarterly and monthly) to fit current definitions in the livestock sector and thereby to use current data to the extent possible. Three primary decision problems are being treated in the system of economic analysis, namely, (a) the size of the reproduction base, (b) the temporal allocation of the calf crop to feeding programs, and (c) the temporal allocation of feedlot inventories to forward weight classes (within implied grade changes) and slaughter. Among the key data needs, including some data not currently available, are a comprehensive beef feedlot inventory system, placements and disposition data, pre-feedlot inventories on calves, feeder-stock, cows and other reproduction base animals by sex, weight and growth characteristics, timely data on beef import-export balances, data on the volume of meat product stocks, and utilization and terminal consumption of meat products.

B. Appraisal of Adjustments in Dairy Areas

1. Work on dairy adjustments and supply response continued in the cooperating Northeast States. A regional bulletin on dairy adjustments in the Northeast was published. It describes dairy production in the Northeast and the research technique of using farm models in conjunction with linear programming to estimate aggregate supply. Regional demand functions for milk were compared with regional supply functions.

2. In Maine, a study of herd-size adjustments and short-term implications was made for two major milk production areas. The overall picture for the Maine coastal area does not indicate any appreciable growth in the number of farms with 80 or more cows. Results, using Markov processes, suggest that there may be a contraction in herd size on many farms in the southern area of the State. Growth probabilities in central Maine appear much greater and an increasing proportion of dairymen may expand to units with 80 or more cows. Sugarbeets as an alternative for Maine dairymen were evaluated. Responses were estimated for a broad range of milk and sugarbeet prices. In response to higher beet prices, forage production would be intensified through shifts to alfalfa and corn silage. For beets to be competitive, beet prices higher than \$10 per ton at the farm would be necessary.

An important requirement for the estimation of an aggregate milk supply function is the ability to predict milk cow numbers. A regression model was structured to include trends in number of dairy calves and dairy heifers. Elimination practices for the producing herd were captured in the model. Projections for the next four- to five-year period indicate not only a continuation in the downward trend in the Maine dairy herd, but also an acceleration in the rate of decline.

3. Efforts in Pennsylvania were directed toward a study of the predictive qualities of several response models. Milk output estimates for a 15-county area of Southeastern Pennsylvania were derived for 1961 through 1965 with (a) a linear programming model, (b) a recursive programming model and (c) a regression model. Results were compared with reported milk production in the area for the test years to determine the predictiveness of the various models. The regression model gave the best estimates. The shorter term (one- and two-year) regression projections generally gave smaller errors of estimate than longer term projections, and the regression model seemed to be a better predictive device for estimates of up to five years. Results of this research have been useful in selecting estimating techniques for use in a recursive spatial equilibrium analysis of the Northeast dairy industry. The project and its results are discussed in an unpublished Ph. D. thesis "An Evaluation of Selected Milk Output Response Models," by Glenn A. Zepp, The Pennsylvania State University, 1967.

4. In Connecticut, an Experiment Station bulletin was prepared on the spatial equilibrium study completed in 1966-67. As a follow-up, a multistage spatial equilibrium model was developed and tested. In the multistage model, recursive

concepts were used to account for lagged supply responses and to separate the fluid and manufacturing milk pricing functions. Work was also initiated on a computer program that will handle the five stages of the model in a series of two consecutive quadratic programming formulations. The project and its results are discussed in an unpublished Ph. D. thesis "A Quadratic Programming Approach to Spatial Equilibrium Analysis for the Dairy Industry in the Northeast Region," by J. C. Hsiao, University of Connecticut, 1967. A publication was also issued.

5. In New York State, a dairy producer panel of 1,700 farms was resurveyed in June through August of 1967. In this resurvey of the panel, which has been in existence since 1960, data were gathered on the characteristics of farms, operators, and markets. Entry, exit, and consolidation of dairy farms comprised the primary focus of this survey. The data have been used to develop the resource bases for the dairy farm adjustment work.

6. A multiple-farm linear programming model was developed to assess income-improving adjustments on dairy farms in the New York-New Jersey Milkshed. Eight typical farms were programmed for maximum income under three milk prices and two market situations. These were defined as (a) a situation in which all farms must be just self-sufficient in production of hay, straw, replacements, corn, and small grains; (b) a situation in which farms were allowed to buy or sell each of these intermediate products.

7. Other work in New York was directed at the "take out-pay back" pricing program in effect in the New York-New Jersey Federal Milk Order. A study was made of the seasonality of milk production. Models were developed relating production of milk and net income over a lactation to month of freshening. These models used data from New York DHIA herds to examine dairy farmers' seasonal adjustment possibilities under the pricing provisions of the New York-New Jersey Order. The analysis considered the effectiveness of these pricing provisions and other seasonal price incentives. It was found that contra-seasonal milk pricing is necessary to provide economic incentives for individual producers to seasonally adjust their production. The present seasonal incentive payment pattern in the New York-New Jersey Market is only slightly preferable to the historic pattern in terms of seasonal adjustment incentives to producers.

8. In Delaware, a detailed survey of forty sizes and types of dairy farms was completed. The survey yielded data on production methods and levels, enterprise combinations, resource limitations and fixity, as well as requirements for each enterprise. Representative farm situations are now being set up to provide the basis for linear programming models. Another phase of the study attempts to predict changes in milk supply by the use of a recursive system of equations, using the macro approach and annual time series data.

9. In Vermont, milk supply potentials for 1980 were estimated with Markov Chain projections using 1963-66 as a base. The projections indicate that by 1980 the number of herds would decrease the least, 27 percent, in areas

with a high intensity of dairying at present. In medium intensity dairy areas, a decrease of 34 percent is projected while in low intensity areas, a 45-percent decrease in number of herds is projected for 1980. The biggest decreases will be among the small-sized herds but the number of large herds will increase.

10. In New Hampshire, a study was completed of the effect on farm income of the forage harvesting system, the date harvest begins, the weather patterns, the method of grain feeding, and the size of herd. A simulation model was used. There appears to be no economic justification for beginning hay operations as early as June first. On the other hand, substantial declines in net farm income are encountered by postponing the beginning of the hay operation to as late as June 30.

11. A study of optimum organizations for dairy farms in Northern New England indicates that the income potential increases greatly with high producing cows and if optimal ratios of cropland to cows are attained. Resources needed to give a specified net income increase greatly when farmers receive lower milk prices or have low quality cows. The optimal ratios of cows to cropland appear to occur on fairly intensive farms.

12. In Wisconsin, a manuscript "Economic Evaluation of Forage Handling Systems" was reviewed and submitted for publication. The survey results from a study of liquid manure handling system are being summarized. At the time of the survey (Spring of 1967), only 43 dairy farms could be found in Wisconsin that had had a liquid system in operation for at least a year. These farms were much above average in size, with an average of 85 cows. The largest cost item in the liquid system was found to be the storage tank with a marginal cost of 40 to 70 cents per cow-day of capacity. Assuming the fertilizer value of the liquid manure was equal to distribution costs, the minimum herd size needed to justify an all liquid system was 58 cows with a free-stall, and 44 cows in a stanchion, barn.

13. In a Wisconsin study of hired labor using farm record data, it was determined that on dairy farms a gross income of \$40,000 is needed to justify a full-time hired man. In 1967 only 1,800 dairy farms in Wisconsin grossed this amount, whereas 13,000 farms had full-time hired workers.

C. Appraisal of Adjustments on Range Livestock Ranches

1. Work on analyses of production problems and adjustments on livestock ranches in the Western States continued under Regional Research Project W-79. The Division is cooperating on studies in California, Oregon, Colorado, and Texas. General objectives of the regional project are to evaluate the current structure and financial situation of representative livestock ranches in the Western States, and to examine the effects of various adjustments in livestock inventories, livestock management, grazing practices, and range resource use on costs and returns of typical ranching operations. Work on the analysis of the current situation on representative ranches was

essentially completed during the past year. A report on this phase of the study will be prepared.

2. In California, an econometric study to predict aggregate range cattle production response to changes in cattle prices, range conditions, and certain other structural changes within the industry was completed during the year. Detailed results of this study will be presented in a publication "Range Cattle Supply Response in California, an Economic Study." Two other reports describing the economic characteristics of California's range cattle and range sheep industries were also completed. These reports, which are currently in the review process, present the major physical and economic factors characteristic of livestock ranches in the range producing areas of California.

3. Range livestock studies in Oregon concentrated on the determination of optimal livestock inventory systems for the range area of Southeastern Oregon. Multivariate regression analysis with Bayesian estimator properties was used as a part of the study. Results of the analysis are reported in a Ph. D. thesis "Optimum Cattle Inventory Systems Under Conditions of Certainty and Uncertainty--Southeastern Oregon" on file at Oregon State University.

4. In Colorado, ranch budgets were completed for the Mountain and Plains ranching areas. Four representative ranch situations were delineated for the Plains area and five for the Mountain area. A report entitled "Resources Costs and Returns on Cattle Ranches in the Mountain Area of Colorado" has been completed and is currently in the review process. Under the assumptions of the study, it was found that returns to capital and management were very low in all of the ranching situations considered. The analysis suggests that a major need of the mountain ranches is to evaluate alternative uses for their financial and physical resources. This has been partially done through the development of linear programming models to evaluate alternative management programs. This work will be continued during the coming year.

5. Ranch studies in Texas evaluated returns to capital and management for some 21 representative ranch operations in the High Plains and Rolling Plains. Adjustment opportunities and possibilities for increasing income through the sale of hunting privileges were also considered. Under the assumption of full ranch ownership and with land valued at current market prices, results of the studies showed returns to capital and management varying from \$1,311 for the smallest ranch considered, to \$117,273 for the largest ranch. Percentage returns were 1.55 percent for the smallest ranch and 2.57 percent for the large ranch. Analysis of adjustment opportunities for a representative ranch in the High Plains over a simulated 10-year period suggested that the yearling stocker system of production may be more profitable than a cow-calf or cow-calf-yearling system. Comparison of returns from different deer hunting arrangements for various sized ranches in the Central Basin of Texas indicated day hunting to be more flexible than season leasing and to have the greatest potential for increasing ranch income. More labor is required to manage day hunting, but deer harvest

rates can be more easily adjusted to desired levels. The presence of surplus operator labor on smaller ranches leads to the conclusion that with day hunting, a more efficient harvest rate and greater income per acre from hunting may be possible for the smaller ranches than for large ranches. Season leasing as usually practiced by the larger ranchers requires less operator or hired labor but results in less efficient deer harvest and less income per acre. Leasing deer hunting privileges by the season, while reserving the option to bring in day hunters to harvest surplus deer, seems to offer an alternative for increasing harvesting efficiency and income from the hunting enterprise.

D. Poultry

A research project classified under RPA 313 was originally established to develop new annual costs and returns series for broiler producing and egg producing farms in the Eastern States. This project has been completed and terminated. The series thus developed are now included in a comprehensive, overall Research Work Unit that covers the maintenance and publication of annual costs and returns on 32 types of farm throughout the U. S. The overall project has been classified under RPA 316 "Individual Farm Adjustments and Management." Accordingly, progress on poultry costs and returns are reported under RPA 316, I, "Farm Costs and Returns."

Publications - USDA and Cooperative Program

A. Appraisal of Adjustments in Feed-Livestock Areas

Allen, George C. and Devers, Margaret. 1967. Supplement for 1967 to livestock-feed relationships, 1909-1965. Supplement for 1967 to Statis. Bul. No. 337. 31 pp.

Colyer, Dale and Irwin, George D. 1967. Beef, pork, and feed grains in the Cornbelt: Supply response and resource adjustments. Univ. of Mo. Res. Bul. 921. 113 pp.

Edwards, R. L., Skelley, G. C., Jr., Eaddy, D. W., Godley, W. C., Wheeler, R. F., Hubbard, J. W. and Gilliam, H. C., Jr. 1968. A comparison of drylot and supplemented pasture systems for finishing beef cattle. S. C. Agr. Expt. Sta. Bul. 537. 36 pp.

Johnson, J. B. and Vaile, R. E. 1968. Characteristics of the Pacific Northwest beef industry. Oreg. Agr. Expt. Sta. Special Rpt. 256. 66 pp.

Johnson, Ralph D. and Eckert, Alfred R. 1968. Cattle feeding costs in Nebraska by system of feeding and size of operation. Nebr. Agr. Expt. Sta. S. B. 496. 45 pp.

Sharples, Jerry A., Miller, Thomas A. and Day, Lee M. 1968. Evaluation of a firm model in estimating aggregate supply response. North Central Regional Research Publication No. 179. Iowa Agr. and Home Econ. Expt. Sta. Res. Bul. 558. 61 pp.

Tompkin, J. R. and Rafeld, F. J. 1967. Actual and optimal adjustments on 320-acre farms in west-central Ohio, 1957-1959. Ohio Agr. Expt. Sta. Res. Bul. 1002. 30 pp.

B. Appraisal of Adjustments in Dairy Areas

Christensen, R. L. and Frick, G. E. 1968. Rent your cows to somebody else? Hoard's Dairyman. pp. 136-137.

Cloud, C. C., Frick, G. E., and Andrews, R. A. 1968. An economic analysis of hay harvesting and utilization using a simulation analysis. N. H. Agr. Expt. Sta. Bul. 495. 55 pp.

Department of Resource Economics, New Hampshire Agricultural Experiment Station. 1968. Dairy adjustments in the Northeast--an analysis of potential production and market equilibrium. (Report of the Northeast Dairy Adjustments Committee.) 46 pp.

Hsiao, J. C. and Kottke, M. W. 1968. Spatial equilibrium analysis of the dairy industry in the Northeast region--an application of quadratic programming. Storrs (Conn.) Agr. Expt. Sta. Bul. 405. 30 pp.

Kottke, M. W. 1967. A short-cut approach to the use of linear programming for solving on-the-farm problems. Storrs (Conn.) Agr. Expt. Sta. Res. Rpt. 26. 44 pp.

C. Appraisal of Adjustments on Range Livestock Ranches

Boykin, Calvin C. 1967. Profitability and flexibility of two range cattle systems in the Rolling Plains of Texas. Jour. Range Mgmt. 20(6), 4 pp.

Boykin, Calvin C. 1967. Maximizing profits under conditions of variable output. Proceedings of Great Plains Agricultural Council, College Station, Texas. Aug. 3-4, 1967. 9 pp.

Boykin, Calvin C. and Cartwright, T. C. 1967. Beef cattle production techniques which may have major economic implications in the South. Tex. Agr. Expt. Sta. Dept. of Agr. Econ. and Soc. Infor. Rept. 16. 21 pp.

Boykin, Calvin C. 1968. Economic and operational characteristics of cattle ranches--Texas High Plains and Rolling Plains. Tex. Agr. Expt. Sta. MP 866. 20 pp.

Boykin, Calvin C. 1968. Development of synthetic ranches for evaluating potential adjustments. Abstract of papers, 21st annual meeting, American Soc. of Range Mgmt., Albuquerque, N. Mex., Feb. 12-15, 1968. 1 p.

Boykin, Calvin C. 1967. Costs and returns from commercial breeding operations. Tex. Agr. Expt. Sta. An. Sci. Dept. Tech. Rpt. 10. 15 pp.

McCorkle, C. O., Jr., Ching, Chauncey T. K., and Carr, Donald E. 1968. Economic and physical characteristics of representative range livestock ranches in California. Univ. of Calif. Agr. Ext. Serv. 18 pp.

Sharp, Wayne W. and Boykin, Calvin C. 1967. A dynamic programming model for evaluating investments in mesquite control and alternative beef cattle systems. Tex. Agr. Expt. Sta. Tech. Mono. 4. 38 pp.

Wheeler, Richard O. 1967. Determining grazing fees on National Forests--a discussion. In Proceedings, Western Agricultural Economics Research Council Range Committee, 1967 annual meeting, Reno, Nev. Sept. 12-13, 1967.

D. Poultry

Publications are reported under RPA 316 "Individual Farm Adjustments and Management," I, "Farm Costs and Returns."

INDIVIDUAL FARM ADJUSTMENTS AND MANAGEMENT
(RPA 316)

USDA and Cooperative Program

Location of Intramural Work	Subject	Scientist Man-years FY 1968
Arkansas	Rice adjustments	1.0
Louisiana	" "	1.0
Mississippi	" "	0.1
Texas	" "	2.0
Montana	Wheat adjustments	1.0
North Dakota	" "	1.0
South Dakota	" "	2.0
Colorado	" "	2.0
Kansas	" "	1.0
Nebraska	" "	1.0
Oregon	" "	2.0
Washington (State)	" "	1.0
California	Cotton adjustments	2.0
Mississippi	" "	1.6
Georgia	Cotton, tobacco, peanut adjustments	0.7
Kentucky	" " " "	2.0
North Carolina	" " " "	1.0
South Carolina	" " " "	1.0
Tennessee	" " " "	1.0
Virginia	" " " "	1.0
Arkansas	" " " "	0.1
Louisiana	" " " "	1.4
Mississippi	" " " "	0.4
Missouri	" " " "	1.0
Oklahoma	" " " "	3.0
Texas	" " " "	5.0

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Location of Intramural Work	Subject	Scientist
		Man-years FY 1968
Iowa	Regional adjustments	2.0
Illinois	Farm financial management	1.0
Indiana	" " "	1.0
Kansas	" " "	0.3
Michigan	" " "	2.0
Ohio	" " "	2.0
Washington, D. C.	" " "	1.6
Montana	Risks and insurance	1.0
Washington, D. C.	" " "	1.0
Michigan	Pesticide use	1.0
Nebraska	" "	1.0
Washington, D. C.	" "	5.1
Washington, D. C.	Agricultural productivity	2.0
Washington, D. C.	Costs and returns	5.9
Total		63.2

Intramural program is supplemented by a total of 1.8 SMY's at New Mexico, Pennsylvania, and California Experiment Stations and Southern Illinois University.

Problems and Objectives

Farm business management research helps farmers adjust to the continuing process of technological, economic, and social change. Purchased inputs are increasingly being substituted for labor and land. New improved technology changes the competitive position of alternative production methods and systems. New ways of doing business with supply and marketing firms require new types of decisions by farm operators, and open up new sources of financing. Changing market demands require adjustments in products produced. The large investments required for today's commercial farms emphasize the necessity of sound financial management, including risk and insurance.

Individual farm adjustments and management for livestock and poultry farms are covered under Improved Livestock and Poultry Production Management Systems (RPA 313).

Adjustments made on individual farms and overall adjustments in total supply are interrelated; each influences the other. Continuing analyses of trends in farm output and productivity are needed. Also needed are continuing appraisals of aggregate production response and needs for adjustment as discussed under Government Programs to Balance Farm Output (RPA 808).

Major objectives of the research are to:

1. Determine and appraise the need for, profitability of, and obstacles to, adjustments (for other than primarily livestock farming).
2. Formulate and evaluate improved production plans or systems including size of business, combinations of enterprises, and new or improved practices and technology.
3. Identify and evaluate the elements of sound farm financial management.
4. Determine current and prospective trends in farm output and productivity.
5. Determine costs and returns on representative farms by major types of farming.

Progress - USDA and Cooperative Program

A. Appraisal of Adjustments in Rice Areas

1. In a continuation of a study of adjustments in rice areas of the South, the emphasis is now on estimating the effect of tenure arrangements on supply response for various allotment and price combinations. The work on this phase of the study is just getting underway; however, some preliminary analysis in Texas indicates that supply response is similar to that determined

previously for owner-operators but the returns to the tenant-operator are considerably lower.

2. In response to a special request from the Office of the Secretary, a study was made of current costs of producing rice in the various rice producing areas of the South. A publication is in process showing the input-output budgets and the cost and returns for owner-operators as well as for tenant-operators under the conventional land rental arrangements for the various rice producing areas of Texas, Louisiana, and Arkansas. Based on 1964 to 1966 average yields, the cost per hundred pounds for producing rice for owner-operators averaged \$3.41 in the Grand Prairie of Arkansas, \$3.46 for Northeast Arkansas, and \$4.33 for the Mississippi River Delta area. In Texas the cost per hundred pounds of rice ranged from \$3.86 to \$4.07 for a tenant-operator, and \$3.96 to \$4.28 for owner-operators.

3. During the summer of 1967 approximately fifty rice and fifty soybean schedules were taken in the Louisiana rice area in order to evaluate the phenomenal increase in soybean acreage on rice farms, and to update costs and returns. The data have been used to develop new budgets, and to show changes that have occurred in rice and soybean inputs and outputs. The data showed that between 1962 and 1966, tractor prices increased about 44 percent and implement prices about 29 percent, but machinery costs per acre of rice increased only 10 percent because of larger and more efficient implements. The analyses from the data also showed that the use of herbicides on rice resulted in significant changes in irrigation practices, which were primarily responsible for labor inputs decreasing by about 39 percent. Even though labor costs per hour increased about 90 percent between 1962 and 1966, the cost of labor per acre of rice increased only 24 percent.

4. In the Arkansas Grand Prairie production area, the results of an equipment and labor study indicate that the optimum equipment complement on rice farms is influenced heavily by weather risk patterns during critical planting periods. Optimum equipment combinations have been derived for various farm sizes and various weather risk situations. For example, based on the "restricted weather condition," a 961 to 1200 acre farm requires a five-tractor equipment complement and three and one-half man years of labor. The results of the study, soon to be published by the Arkansas Experiment Station, will show the marked variation in income that may be caused when adverse weather conditions reduce the number of days available for performing critical field operations. Net farm income varies by 25 percent or more between the more favorable and least favorable weather years largely because critical operations are not performed on time.

5. In California, work progressed on rice studies in the Sacramento and San Joaquin Valleys. Representative farm sizes ranging from 120 acres to 2,960 acres, along with linear programming and chance constraint programming, were used to estimate supply response under alternative assumptions as to prices for rice and production controls. The program results indicated that rice output for 1966 could be supplied with an average price of \$4.16 per

hundredweight if there were no production controls or price support programs. At this price, however, the 120-acre farm situation indicated negative net farm income considering all fixed costs.

B. Appraisal of Adjustments in Wheat Areas

1. Work is nearing completion on current studies of adjustments in wheat areas in the Great Plains and Pacific Northwest. The studies are in cooperation with Regional Research Projects W-54 (West) and GP-5 (Great Plains). Work during the year was concentrated on area and regional aggregation of production response, resource requirements, and farm income, and on the preparation of area and regional reports. The studies will be completed during the coming year.

2. Studies were continued in Kansas to include additional programming for the four adjustment areas at wheat prices below the feed grain equivalent for wheat. It was found that some wheat would be produced at these lower prices, in some cases at 35 to 50 cents per bushel. Other programming was directed at determining the level of wheat prices needed to change the use of irrigated land. Results show the effect of wheat prices on the acreage of irrigated wheat per farm and number of sprinkler irrigations on wheat and grain sorghums. Fixed cost data were developed for some of the programmed farms in preparation for publication. Work was begun on a manuscript "Effects of Wheat-Feed Grain Prices on Farm Organization and Income, Area II." Information on resources for representative farms in Area I and Area VII were assembled. Farms in this area will also be programmed.

3. A report for Colorado "Aggregate Supply Responses for Eastern Colorado Wheat Farms" was completed and is in the review process. This report analyzes data for eastern Colorado's wheat and feed grain production on cash grain farms on a firm basis for five areas, and on an aggregate basis. Results of the study suggest that, without including land costs, maximum income would accrue to wheat farmers with about 35 percent of their cropland planted to wheat if: Feed grains are low in price and wheat sells for slightly more than 60 cents a bushel, or feed grains are medium in price and wheat sells for 80 cents a bushel, or feed grains are high in price and wheat sells for nearly \$1.40 a bushel. Looking at the aggregate supply, it is apparent that the proportionately largest supply response associated with changes in wheat prices is at the lower price level. With medium feed grain prices, a one-third increase in the wheat price (\$0.60 to \$0.80 a bushel) more than doubles the production and acres seeded to wheat. Again, with medium feed grain prices and starting with a slightly higher wheat price, a one-fifth increase in the wheat price (\$1.00 to \$1.20 a bushel) increases production and acres seeded to wheat about 10 percent.

4. In North Dakota, a study of the minimum resources required to generate specified levels of income was completed. This study shows that an operator would need 1,100 acres in a cash grain farm or 3,800 acres for a livestock ranch to produce a \$10,000 return to the operator. Farm numbers would have

to decrease by 60 percent in order for all farms to meet an average \$10,000 return to labor and management. A study to determine least-cost combinations of machinery, considering timeliness of operation, was completed. The study was based on a planting period of 34 days. This study also determined the break-even point between owning and custom hiring of equipment. A study was completed on the wages and benefits presently offered to full-time hired workers in North Dakota. The results indicated that on the average, full-time hired farm workers received \$5,157 annually in cash wages, fringe benefits, and incentive payments. A study of cost economies in livestock production was completed. The results indicated that cost economies of size exist for cattle ranches in North Dakota. The lowest average-cost beef cattle ranch was found to be about 275 cows. The adjustment toward fewer and larger cattle ranches can be expected to continue.

5. Work progressed in South Dakota on a manuscript "Characteristics of the Farms and Ranches in the Belle Fourche Area." This report shows the net worth of representative farms and ranches and the ratio of debts to assets. The debt to assets ratio was the lowest on small irrigated farms and on the larger dryland farms and ranches. About 25 percent of the farm operators and 10 percent of their wives reported off-farm income. The addition to farm income from off-farm work averaged about \$825 per farm. A series of manuscripts reporting machine costs for the machinery complement on the representative farms in each area were also completed. These reports will be published by the South Dakota Experiment Station. To provide an economic interpretation of irrigated pasture studies at the Newell Field Station, budgets have been prepared to evaluate the net cash returns for beef production on irrigated pastures compared with returns from corn, alfalfa, or small grains. The budgets will indicate the yield of other crops necessary to equal the return from beef production on pasture.

6. In Montana, work was completed on the GP-5 and W-54 Regional Research Projects. Results of the Montana study will be included in the regional report. A descriptive study of farming adjustments in Montana in recent years, based largely on data from the U. S. Census of Agriculture, was completed. Major findings show noticeable shifts from cropland to grassland in the State, an aggregate reduction of diversified farming in favor of circumscribed specialization, and a substantial decline in the number of farms in Montana. Also during the year work progressed on a study of supply responses of Montana wheat, barley, and beef to price changes. Tentative findings indicate that, under current price relationships, marginal land taken out of wheat should probably go to livestock production rather than to barley. Other related activities included preparation of a report on fertilizer use in Montana. This report is currently awaiting publication. An article based on the report was prepared for the annual fertilizer issue of the Montana Farmer-Stockman.

7. In Oklahoma, aggregative estimates for major crops in three study areas were completed and will be included in the GP-5 regional publication. Preliminary programming was started on a minimum resource model. This work has

thus far been concentrated in the North Central Oklahoma study area. Additional work was also initiated in the Oklahoma Panhandle study area to focus on efficient use of irrigation water, the expected life of water supplies, and the effects of different methods of water-use regulations on farm production, resource use, and income.

8. In Texas, analyses of farming adjustments in wheat producing areas were continued. Programming results for the Southern High Plains showed that with prices of \$22 per cwt. for cotton lint, \$1.73 per cwt. for grain sorghum and \$1.65 per bushel for wheat, the area would produce 3.25 million acres of cotton, 1.95 million acres of sorghum and 0.75 million acres of wheat in the absence of acreage restrictions. Cotton production was relatively insensitive to changes in wheat prices but highly sensitive to changes in cotton and sorghum prices. At the assumed wheat price level, wheat production was not affected by changes in sorghum prices, but was affected by decreased cotton prices. Wide changes in wheat prices would be required to affect wheat production significantly. Sorghum production was found to be highly sensitive to changes in cotton prices but relatively insensitive to moderate changes in wheat and sorghum prices.

9. In Idaho, results of the study in the dryland area of southeastern Idaho indicated that farm machinery investments will range from \$34,567 on 1,000-acre farms to \$85,775 on 3,000-acre farms by 1970. Average total costs of production on 1,000-acre farms were estimated to be \$21.78 per acre for wheat and \$23.87 per acre for barley, in 1970. Economies of scale were observed on 2,000-and 3,000-acre farms; however, the principal incentive for increasing farm size probably is to raise income levels. Supply curves based on production and cost relationships were highly inelastic. Wheat will continue to be planted in preference to barley under free market conditions. It is doubtful that the economic problems of the dryland wheat farmer will improve in years to come unless prices are substantially higher than they have been, or technology introduces new and more productive crops, or provides a fertilizer specifically for dryland conditions.

10. In Oregon, results of the production response study were summarized for inclusion in the regional publication of the W-54 and GP-5 projects. The study area in Oregon includes a major part of the five Columbia Basin counties known as the wheat-fallow area of Oregon. In aggregate, the combined acreage of wheat, barley, and fallow has been nearly invariable over the last ten years in this area. Results of the study indicate that, with no production controls, wheat acreage is expanded at the expense of barley. In the study, maximum allowable expansion was held to the smaller 1953 wheat acreage or one-half of the total crop acreage on farms producing wheat minus the "permanent" conserving base. This allowed total wheat acreage and barley acreage to expand to 616,800 acres, as compared to the 574,400 planted to wheat in 1964. Wheat yields were assumed to be lower on acreage in excess of the 422,400 acres of wheat planted in 1964. The maximum increase in wheat acreage was 46 percent; the maximum increase in production was 41.5 percent. Assuming that the price of barley did not exceed the price of

wheat on a pound for pound basis, wheat acreage would expand from 601,500 acres at 51 cents per bushel to a maximum of 616,800 acres at \$1.00 per bushel. Evidence suggests that a wheat price of approximately \$1.30 per bushel would be required to cover current market opportunity costs for resources used in wheat production in all the sub-areas considered.

11. In Washington, final aggregation of programming results for the W-54 regional project was completed. The data for the three Pacific Northwest States were aggregated for inclusion in the regional publication for all W-54 and GP-5 cooperating States. This publication is in manuscript form. The data from this study for the State of Washington have been incorporated into another manuscript which has been submitted for publication. A reactive programming model for the U. S. wheat industry is being constructed. Data have been collected on the supply response of wheat in various regions of the U. S., and an analysis of regional demand functions for wheat is currently in progress. A master's thesis was written on the economics of machinery selection on Eastern Washington wheat farms. A publication from this work is in progress.

C. Appraisal of Adjustments in Cotton, Tobacco, and Peanut Areas

1. During this reporting year, a major cooperative research effort over the past ten years was officially completed. The S-42 Regional Research Project, in which the Farm Production Economics Division has had a large research commitment, was terminated July 1, 1968. In addition to many cooperative State publications over the life of S-42 there have been two regional reports published and two more are in process of publication. One of these deals with an analysis of the resources required for a \$5,000 operator income under various allotment situations and price conditions. As would be expected, it shows that the land required for a \$5,000 income varies tremendously from area to area in the southern cotton producing areas.

2. Another regional report soon to be published in connection with S-42 examines the supply response of tobacco in the major burley tobacco areas of Kentucky, Tennessee, and Virginia. The analyses reported in this publication show the tobacco production, farm organization, and farm income for various allotment levels and prices of tobacco. The area results show that burley tobacco is by far the most profitable crop, and that considerable acreages would be produced even at the lowest prices evaluated.

3. In an allied research activity based in Kentucky, the location of burley tobacco production under some alternative Government control programs was analyzed. A programming matrix for nine regions of the Burley Belt was developed and the effect of tobacco prices ranging from 35 cents per pound to 90 cents per pound, and allotment levels ranging from 40 percent of the 1966 allotment to 140 percent, were evaluated in each of the nine areas. The results indicate that the Inner and Outer Bluegrass regions of Kentucky, the Western Pennyroyal area of Kentucky, and part of the Highland Rim of Tennessee have a comparative advantage in the production of burley tobacco.

A Ph. D. dissertation, nearing completion, reports the results of this study.

4. In Texas a study is still in progress that will assess the economic impact of a declining water supply in the Texas High Plains. The study area was delineated into 80 water and other resource situations. A linear programming model incorporating decreasing quantities of water at increasing unit costs was used to ascertain the farm organization providing the maximum annual farm income consistent with full recovery of the investment in irrigation facilities. The results so far are tentative, but indications are that irrigation water supplies will decline sharply over the next several years resulting in lower farm income and smaller quantities of cotton and feed grains produced.

5. In the Mississippi Delta a survey was made to obtain data on performance rates, size of labor force, and the number and size of tractors used on Delta farms. Tabulation of the data has been completed and the analysis is in process. The survey indicated a sharp increase in the use of 6-row farm equipment with a concomitant decrease in the quantity of labor used. The study of various herbicides and their effect on production practices and costs continued in the Mississippi Delta. Data from the 1966 and 1967 crops indicated that post-emergence weed control costs were not significantly affected by the kind of pre-emergence herbicide used. The tests using the least expensive pre-emergent herbicide had the lowest total weed control cost. The yields from these tests were equal or superior to those obtained in the tests in which more expensive pre-emergence herbicides were used.

6. In Louisiana, work has continued on the analysis of data previously collected for the purpose of developing improved input-output coefficients for the major crops in the Mississippi River Delta area. A soil moisture accounting system has been developed and used to generate estimates of days available for field work. A report is in process of publication.

7. In Texas, peanut production responses for various price and allotment situations were analyzed in the two major peanut producing areas of the State. A manuscript is being prepared in which estimated production requirements, costs, and expected returns for one of the peanut producing areas are presented. Representative farm resource situations have been developed and analyzed for optimal resource use and enterprise combinations. One representative resource situation is a 675-acre farm with 112 acres of peanut allotment. At current price and allotment levels, a \$6,347 return to operator labor, management, risk, and land is indicated. However, after the deduction of a land charge, a residual return of \$1,791 is left for operator labor, management, and risk. The optimal organization for this same farm without a peanut allotment results in an estimated return to operator labor, management, risk, and land of only \$1,822.

8. Another phase of the analysis in Texas was the determination of the minimum starting equity required to satisfy various consumption levels, pay

taxes, and growth at a specified rate for a dry-land, cotton-grain sorghum farm in the High Plains of Texas. Minimum starting equity requirements, assuming constant prices and historical yields over a 15-year growth period, ranged from \$26,000 for a full tenant to \$1.5 million for a situation where full ownership of the land was assumed.

9. In California, farm budgets were completed and aggregated for all cotton producing areas in the San Joaquin and Imperial Valleys for present and projected technologies under a wide range of product prices. A draft of a manuscript "Cotton Supply Response and Related Farm Resource Use in California," has been completed and is in the review process. This manuscript is a summary of the results of the study, with main emphasis on showing the normative cotton supply response of the included areas with changing market prices of cotton or with continuation of existing support programs.

10. In New Mexico, a study of farm adjustment opportunities is well under way. Farm survey data are being summarized and enterprise budgets are being developed using projected 1970 input costs and commodity prices. Budgets at 1970 prices show cotton to be the most profitable in Lea County. Historical prices suggest that head lettuce may be the most profitable crop in the Mesilla Valley. Net returns from onions are \$100 per acre above upland cotton.

D. Regional Adjustments

A linear programming analysis of interregional adjustments in crop and livestock production on a national basis was published. A major objective was to formulate and test mathematical models that are more realistic in accounting for regional and commodity interdependence within agriculture by including not only the wheat, feed grain, soybean, and cotton sectors of the economy but also the forage, hog, beef, and dairy production sectors.

E. Farm Financial Management

1. Emphasis was given during the year to refining concepts for partitioning farm financial returns to investment, ownership, and entrepreneurship. Further study also was made of basic principles of farm financial management, and a conceptual framework for research in that subject has been developed. Two manuscripts were completed which, when published, should serve as benchmarks for future research in farm financial management.

2. Financial management research in Indiana focused on determining "rules" for the processes involved in farm business decision-making. The means of including external factors facing a farm firm, as well as uncertain events such as prices and yields, were determined for inclusion in a computer simulator. Consideration is being given to various growth strategies and conditions for growth, including land ownership vs. renting, use of livestock,

length of loan repayment, size of downpayments, enterprise flexibility, size of land purchases, and price and yield expectation strategies.

3. The simulation model prepared for use in studying financial management on Pennsylvania dairy farms was redesigned and extensively tested. A particular problem analyzed with the model related to decision-making in the use of Federal crop insurance for hypothetical farms of the type found in south-eastern Pennsylvania. Costs and benefits were analyzed in a dynamic framework. Loss experience was simulated by a stochastic process.

4. In Central Florida, an analysis of beef cattle ranches showed that net returns to investment, labor, management, and risk ranged from \$16.67 to \$20.40 per animal unit. Average animal units per representative ranch ranged from 43 to 3,131.

5. A completed study of beef feeding farms in Illinois revealed that many operators cannot pay for automated feeding equipment unless the cattle gain in grade. The budgets also indicated that investments in storage facilities beyond those needed for home-produced grain usually do not pay; that short-fed cattle should be fed only on larger farms and yearling cattle should not be fed at all; and that returns from a system with horizontal silos and fence line feed bunks are larger than with tower storage and auger feed bunks.

6. Farmers in southern Illinois reported a preference for using credit rather than leasing when expanding resources. Farmers were most willing to lease land, then livestock, and lastly machinery. The acceptance of leasing livestock and machinery was improved by an option to buy, but not much by changes in leasing rates.

7. If larger-scale farming operators in Michigan are to get adequate financing they must be prepared to provide the lender more detailed information. Such information includes comprehensive budgets and plans that will help the lender analyze loans. Farmers must also accept the lender more nearly as a partner. The study showed that some lenders are somewhat skeptical of large loans, and their policies and procedures are constantly changing to maintain more control over low-equity operators. Also shown was the need for appropriate loan repayment terms on the bigger farms, particularly those having a large amount of their financing on long-term real estate security.

8. Another Michigan study of methods of financing the growth of dairy farms showed that farm incomes as a percentage of parity returns improved as gross sales increased. However, only half of the largest farms with gross sales of \$40,000 or more had parity ratios above 100 in 1966. It was recognized that parity returns are not a complete measure of the well-being of farmers; age, education, and off-farm income must be considered.

9. An analysis was made of the growth of commercial cash grain-hog farms in Ohio. The results indicate that those with faster growing assets had

operators who: (a) were younger, (b) possessed a more positive credit-use attitude, (c) tended to rank growth as the most important goal, (d) reported little additional land available for leasing or purchasing, (e) had families with more children at home, and (f) had a lower percentage equity in the farm business.

10. Growth of farm firms and the ability to cope with risk in Kansas appeared to be related to the amount of labor and capital managed. A regression analysis showed that the volume of these two types of resources accounted for almost 70 percent of the variation in gross income between farms for 1950-64. A full-time man added about \$7,500 to gross income, and \$1.00 of capital added about \$0.11. A dollar of working capital added about \$0.28, but \$1.00 of real estate capital added only \$0.03 to gross income. The number of acres usually was not statistically significant. Age seemed important. The degree of income variability was not significantly related to gross income received for the entire period.

11. A study that will analyze the financial management practices of farmers in the irrigated Columbia Basin and wheat-pea areas of Washington has been initiated.

F. Agricultural Risks and Insurance

1. Series of wheat yields for 1940-64 have been prepared for a sample of individual farms in major wheat-producing counties in Montana. These series show the long-term production risks in various sections of the State, and will be a basis for studying trends in yields, particularly as they may be affected by new technology. Fertilizer use, which is believed to affect the level and variability of wheat yields, is currently under study.

2. Farm property losses from fire in 1967 are estimated at \$208 million. Farm mutual insurance company data indicate that most losses are small, and that a \$50 deductible would reduce company costs and premium rates. Analysis of 1965 losses under the "farmowners package" policies shows 46 percent of losses to be from fire, 38 percent from wind, 9 percent from personal liability and medical claims, and 7 percent from other causes. Fire and wind indemnities averaged about \$350 and \$200 each.

3. Statistics from the Department of Health, Education, and Welfare revealed that about 42 percent of all fatal accidents on farms in 1966 were machinery and tractor accidents, up from 39 percent of all accidents in 1960-64. The proportions of fatalities from drowning and firearms were about 15 and 10 percent, respectively, down slightly from 1960-64.

4. An analysis of the relatively new "farmowners package" policy shows that use of it continues to spread rapidly among commercial farms, particularly in the Corn Belt. This policy has advantages in providing broader protection at reduced cost, but only owner-controlled farms with dwellings valued at \$8,000 or more can usually qualify for it. Small farmers' mutual insurance

companies have been slow in adopting this policy, mainly because of the personal liability feature.

5. An evaluation of Federal all-risk crop insurance shows it to be only one of the ways to cope with crop production losses. Others include financial and credit reserves, feed and grain reserves, timing of capital outlays, Federal price support programs, and Farmers Home Administration emergency loans. Specialized crop-hail insurance also is very important, it is taken by twice the number of farmers that take Federal crop insurance (FCI). Crop-hail coverage is about five times the FCI coverage. Four-fifths of FCI participation is in wheat, tobacco, corn, cotton, and soybeans. Leading States are North Carolina, Minnesota, Iowa, and North Dakota.

G. Economics of Pesticides Use in Agriculture

1. The presentation and interpretation of statistics related to costs and practices for controlling plant and animal pests is the initial phase of the research on the economics of pesticide use in agriculture. Most of the statistical data are from two surveys of about 10,000 farm operators in 417 counties of the 48 contiguous States: (a) the 1964 Nationwide Pesticide Uses Survey and (b) the 1966 Pesticide and General Farm Survey.

A report published this year "Quantities of Pesticides Used by Farmers in 1964" shows quantities of the more than 100 different active ingredients that farmers use in their agricultural operations to control pests. The major results were summarized in last year's Progress Report.

2. A report "Farmers Pesticide Expenditures for Crops, Livestock, and Other Selected Uses in 1964" has been cleared for publication. It contains revised and more detailed data related to farmers' expenditures for pesticides than were published in 1967. In 1964, for pesticide materials alone, farmers spent an estimated \$479 million -- \$424 million for crops, \$31 million for treating livestock, \$8 million for rodent control, and \$16 million for treatment of land not in crop production. Among individual crops, more money was spent -- \$114 million -- for pesticides used on cotton than for any other crop. Over 90 percent of the acreage of apples, other deciduous fruits, and tobacco was treated. Almost 60 percent of the corn, the most widely grown crop, was treated. Animals were treated during the year by almost three-fourths of the farmers with livestock. Over half of the expenditure for the treatment of livestock was to treat beef cattle.

3. Another report "Farmers Expenditures for Custom Pesticides Services in 1964" has been cleared for publication. This report shows that, because of the specialized nature of agricultural chemicals, farmers use custom pesticide services extensively. Farmers in the 48 States spent about \$173 million for custom pesticide services in 1964, including cost of application and materials. Nearly \$172 million was spent for controlling crop pests, and slightly less than \$2 million for controlling livestock pests. About one-third of those using any pesticides on crops in 1964 used some custom

services. The cost of custom-applied pesticide materials alone was \$115 million, or one-fourth of all pesticides used by farmers in 1964. The cost of application varied from 19 percent of the total custom cost for vegetables other than potatoes to 75 percent for hay and pasture. Cotton was the major crop on which custom pesticide services were used. Forty-three percent of the farmers using pesticides on cotton used some custom services.

4. A report "Extent of Farm Pesticide Use on Crops in 1966" has also been cleared. It shows that over half of U. S. farmers use weed, insect, or disease control chemicals in the production of their crops. In 1966, about 37 percent of the farmers growing crops used herbicides, 29 percent used insecticides, 4 percent used fungicides, and 8 percent used other pesticides (including defoliants, desiccants, growth regulators, miticides, and rodenticides). Herbicides were applied on over half of the corn, cotton, rice, peanut, and potato acreage. Considering all crops, about 27 percent of the land area (not including pasture and rangeland) was treated with weed control chemicals in 1966. Insecticides were used most extensively on tobacco, peanuts, fruits and vegetables. For these crops, over 50 percent of the acres received insecticide treatment. However, only 12 percent of the total crop acreage (not including pasture and rangeland) was treated. Disease-control chemicals were used on more than 70 percent of the citrus and apple acres and on a large share of the other fruit, peanut, and vegetable acreage. However, these applications were on a very small portion of the total crop acreage -- about one percent.

5. Preliminary results from a cooperative survey conducted jointly by the Agricultural Research Service, Federal Extension Service, and the Economic Research Service show that the use of herbicides in the United States continues to increase. Weed scientists in the 50 States estimated that nearly 84 million acres were treated with post-emergence herbicides in 1965 as compared with 55 million in 1962 and 49 million in 1959. Also, 36 million acres were treated with pre-emergence herbicides in 1965 as compared with 15 million in 1962 and 4 million in 1959. Some of these acres were treated with both pre-emergence and post-emergence materials.

6. A study in California dealing with the use of simulation and dynamic programming techniques to evaluate red scale on citrus is in progress. Basic data (published and non-published) were collected on the biologies of the red scale and the parasites. It has been determined that a pest-predator model using the "micro" approach is not feasible because of the lack of compatible data. Work has begun on the building of a "macro" pest-predator model.

7. Another study in California has been initiated to evaluate the consequences of relevant spray strategies in the control of brown rot on peaches. "Decision rules" for pesticide use which will increase expected payoffs for the individual firms will be developed from climatological rain frequencies and rain forecasts, and from subjective probabilities of various intensities of brown-rot infestations.

8. At Michigan State University, a preliminary regression analysis of soybean data for Indiana, from the 1966 ERS Pesticide and General Farm Survey, did not show any significant relationship between soybean yield and selected inputs. The inputs were (a) soil type, (b) method of weed control, (c) quantity and analysis of fertilizer, (d) row width, and (e) type and intensity of weed infestation. A study has been initiated to describe the demand for herbicides in the United States. It will include an analysis of the factors related to the use of herbicides. This information will then be used to estimate the market for herbicides in 1980.

9. In Missouri, the economic analysis of the productivity of pesticides is continuing. Transformed data from the 1964 Pesticide Uses Survey were used in computing some preliminary regressions to relate pesticide input to output for each of the type-of-farming regions in the United States.

10. At Nebraska, data on herbicides used on corn, grain sorghum, and soybeans for 13 Nebraska counties for 1964 and 1966 have been tabulated and a manuscript has been prepared. The data show that herbicide use increased significantly between 1964 and 1966. The cost of herbicides per acre varied considerably between 1964 and 1966, especially for new herbicides and those used on a small percentage of the acreage. In counties where farmers were just beginning to use herbicides the application rate tended to be higher than in counties where herbicides had been used for several years.

H. National and Regional Productivity in Agriculture

1. Final production reports for 1967 indicated a banner year for farm output. Farm output increased 4 percent from 1966 and 18 percent above the 1957-59 average. Total livestock in 1967 increased nearly 3 percent above 1966 and 17 percent above the 1957-59 average. Farm production of meat animals in 1967 was a record high. Production increased for cattle and calves and hogs but was lower for sheep and lambs. Poultry and egg production was at a new high with a record output of eggs, broilers, and turkeys. Dairy products remained at about the same level as in 1966.

Crop production in 1967 was 5 percent greater than in 1966. Sugar crops, cotton, and tobacco were the only crop groups not to attain a record output. Cotton production was the smallest since 1895, and only half the 1961-65 average. Tobacco production increased over the 1966 level. Record corn and sorghum grain output pushed the feed grain total to a new high. Food grain production increased 14 percent above 1966 and 34 percent above the 1957-59 average because of a sharp rise in the harvested acreage of wheat. Oil crops continued to increase, primarily because of a rise in soybean output.

Cropland used for crops totaled 342 million acres in 1967, the greatest since 1960 and 11 million acres more than were used for crops in 1966. Crop production per acre in the United States in 1967 rose from a year earlier, matching the 1965 record high. Among the major field crops setting yield records were corn, rice, all hay, and peanuts.

2. Total inputs used in farming in 1967 were two percent above the 1966 level. Farm output per unit of input was nearly 2 percent greater than the previous year. The composition of inputs continues to change as farmers substitute more productive for less productive inputs. Inputs of farm labor continue to decline, whereas purchased inputs of fertilizer and lime, feed, seed, and livestock continue their long-term upward trend.

3. Reappraisals of prospective crop yields indicated little or no reason for changing earlier yield appraisals. Preliminary projections of U. S. farm output and inputs were made for 1980. Farm output is expected to increase with little change in cropland. Labor inputs will continue downward while purchased inputs will increase at a more rapid rate than in recent years. Overall productivity is projected to continue to increase.

4. A pilot study analyzing the effects of weather and technology on crop yields, conducted jointly with the Iowa Experiment Station, was completed. This study developed a theoretical basis for estimating the aggregate crop yield function as a simple polynomial in several variables representing weather, time, and technological changes. Estimations were derived of the forecasting variance for yield forecasts based on such production functions. Historical data on yield and input variables were analyzed to obtain production functions for corn yields in Iowa and Illinois, grain sorghum yields in Kansas and Nebraska, and wheat yields in Kansas, Nebraska and North Dakota. Yield forecasts through 1971 were derived from these production functions, and the associated forecasting variances were estimated. Finally, use of two decision models demonstrated the usefulness of such forecasts and associated variances in making decisions to meet specified farm policy goals. A report of the results is in progress.

1. Farm Costs and Returns

1. During the reporting year, the costs and returns work was thoroughly reviewed at the Division level. The results of the appraisal are discussed in the introduction to this Progress Report. Twelve of the series scheduled for discontinuation were discontinued. The series that were dropped were those that had largely disappeared from the local economy, or no longer represented a major portion of production, or whose major enterprise could be better represented by another series. A viable ranch series for cattle in the Northern Rocky Mountain area comprised the only new series. This replaced information for a similar but more heterogeneous area.

2. Of the 32 costs and returns series analyzed, 22 farm types showed greater net returns in 1967 compared with a year earlier. Changes in incomes varied widely. Increases in net farm income ranged from one percent on western Wisconsin grade B dairy farms to 27 percent on Delmarva broiler farms, and exceeded 20 percent on 9 of the 22 farm types that showed increases. On the farms with increased net farm income, 18 had greater production and of these, 6 also received higher prices for products sold. Declines in net income from 1966 to 1967 ranged from 2 percent on winter wheat farms in the Southern

Plains to 87 percent on egg-producing farms in New Jersey. For 4 farm types, reductions exceeded 20 percent. Because of relatively low prices for eggs, 1967 incomes on New Jersey egg-producing farms were only 13 percent of the unusually high 1966 returns and 34 percent of the 1961-65 average.

Primarily because of lower farm product prices and higher prices paid for inputs, incomes on hog-beef raising farms in the Corn Belt were 26 percent lower in 1967 than in 1966. Droughts and lower farm product prices were largely responsible for significantly lower returns in 1967 on Southwest sheep ranches and Northern Plains wheat-fallow farms. On the 10 farm types with lower returns in 1967, 9 received lower prices for products sold. On 7 of the 10 farm types, production was higher than in 1966, but not enough to offset the lower prices or higher operating costs.

3. Compared with the five-year period 1961-65, net farm incomes in 1967 were higher on all but two of the 32 types of farms. Those farms with lower returns in 1967 were the egg-producing farms in New Jersey and wheat-small grain-livestock farms in the Northern Plains. Again, the relatively low prices received for eggs kept net incomes on the New Jersey farms at only 34 percent of the 1961-65 average. Drought and lower crop yields and lower prices received relative to the 1961-65 average were responsible for slightly lower net returns in 1967 on the wheat-small grain-livestock farms.

4. Good progress was made in revising and upgrading series in the cotton, Corn Belt, and ranching areas. A comprehensive enumerative survey was completed in the Northern Plains and Northern Rocky Mountain livestock areas.

5. Cooperation continued with the Kentucky and Tennessee Experiment Stations on studies of tobacco in the Central Bluegrass and Pennyroyal areas, with Maine and Delaware in the study of broiler operations, with New Jersey in the study of egg-producing farms in that State, and with New Mexico in the study of Southwest livestock ranches. Other Experiment Stations assisted informally in checking estimates and in consulting and advising.

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STRUCTURAL CHANGES IN AGRICULTURE
(RPA 807)

USDA and Cooperative Program

Location of Intramural	Subject	Scientist Man-years FY 1968
Work		
Washington, D. C.	Capital and credit	5.4
Missouri	" " "	1.0
Washington, D. C.	Real estate	1.7
Nebraska	" "	1.0
Washington, D. C.	Farm size and numbers	2.3
Illinois	" " " "	2.0
Minnesota	" " " "	1.0
North Carolina	" " " "	1.0
Washington (State)	" " " "	1.0
Washington, D. C.	Farm labor	2.7
California	" "	0.3
Maine	" "	1.0
Indiana	" "	1.0
Michigan	" "	1.1
Minnesota	" "	0.6
Washington (State)	" "	0.3
Wisconsin	" "	0.3
Iowa	" "	1.0
Washington, D. C.	Mechanization and practices	1.7
Washington, D. C.	Structure	2.2
Illinois	"	1.0
California	"	0.5
Total		30.1

Problems and Objectives

Research on structural changes provides an understanding of the significance of some of the great changes taking place in agriculture. Among them are the trend toward fewer and larger farms; greatly increased amounts of capital and credit that commercial farms now require; specialization of production; use of vertical coordination and other interfirm arrangements, and accompanying shifts of former farm functions to nonfarm firms; the changing composition of the production-input "mix"; the status and makeup of the farm labor force; and changes in the managerial and entrepreneurial status of the farm operator.

Major research objectives are to determine, analyze, and evaluate:

1. Trends and changes in farm capital, credit, financial condition, and farm real estate values.
2. Trends in numbers, sizes, and types of farms.
3. The changing status and composition of the farm labor force.
4. Trends in mechanization and use of selected production practices.
5. Vertical coordination and other arrangements between farms and nonfarm firms.

Progress - USDA and Cooperative Program

A. Farm Capital, Credit, and Financial Condition

1. The value of farm assets increased by \$11.7 billion in 1967, according to preliminary estimates. The rise was slightly less than the \$13.8 billion increase during 1966. Much of the slower rise was due to net decreases in the value of livestock and poultry and of crops stored on farms. Farm debt, including CCC loans, was expected to increase \$4.2 billion and reach \$49.9 billion by January 1, 1968. Although the rise in farm debt in 1967 was only slightly larger than the \$4.1 billion rise in 1965 and 1966, the growth was a record amount. Because of the slower growth in value of assets in 1967 and a sharper than usual rise in farm debts, owner-equities increased at a slower rate than during the last several years. The \$7.5 billion growth in owner-equities brought the total to \$231.3 billion on January 1, 1968. The debt-to-asset ratio of 18 percent continued the rising trend that began in the early 1940's.

2. The value of farm real estate represents about two-thirds of total farm assets. The comparatively rapid increase in farmland values over the past several years has dominated the increase in farm asset values. Other physical assets comprise about one-fourth of the value of all farm assets. Changes in the value of these other physical assets are small because depreciation and

new additions about offset each other. The value of farm financial assets usually changes little from one year to the next.

3. The use of short- and intermediate-term credit continued strong in 1967. It was estimated that such loans outstanding would rise from \$21.2 billion on January 1, 1967 to \$23.6 billion on January 1, 1968 -- a 12-percent increase. The tight money situation in late 1966 and early 1967 seemed to affect only slightly the availability of short-term farm credit. Interest rates advanced on average in 1967.

4. The supply of long-term farm real estate loans through life insurance companies and the Federal land banks was adversely affected in the last half of 1966 and the first half of 1967 by the tight money situation. However, lending activity of farm mortgage lenders increased sharply in the last half of 1967. For the year 1967, farm mortgage debt increased nearly 9 percent. Interest rates on farm real estate loans increased about 1 percentage point during 1967. The statutory ceiling of 6.0 percent chargeable on Federal land bank loans was removed in late 1967. Most Federal land banks subsequently raised their rates to between 6.25 percent and 7.0 percent.

5. Analysis of data from Federal income tax returns shows that individuals predominate in the farm economy. They account for nearly 96 percent of the returns compared with less than 4 percent and 0.6 percent, respectively, for partnerships and corporations. Individuals reported more than three-fourths of the receipts, partnerships about 11 percent, and corporations about 12 percent. People with farm income would be far worse off without off-farm income. Those with inadequate farm earnings were often in the highest income groups when farm and off-farm income were combined. Farm profits and losses alone are a poor indicator of the income situation of individuals. A report of these findings is in press.

6. A study of social security data shows that half of all unretired individuals with farm income were in the Corn Belt, Northern Plains, and Lake States. Individuals reporting farm earnings were generally younger in the Plains, Mountain States, and Corn Belt than in the rest of the country. One-fourth reported net farm earnings of \$4,000 or more. Nearly half reported less than \$2,000.

7. A study of new farm mortgage loans of the Federal land banks and life insurance companies indicates that their average size has kept pace with increasing land values. Between 1956 and 1966, new land bank loans rose on average from \$10,313 to \$15,380; new life insurance company loans rose from \$24,770 to \$43,830. The average term of new loans increased from 25.9 years to 28.4 years for Federal land banks, and from 18.6 years to 19.9 years for insurance companies. The average ratio of loan to value of security for new Federal land bank loans increased between 1957 and 1966 from 42 percent to 44 percent. For life insurance companies, the average loan-to-value ratio declined from 53 to 50 percent.

8. A completed study of new borrowers obtaining operating loans from the Farmers Home Administration shows that a large proportion had relatively few assets, low equities, and small farm receipts as compared to most new bank and Production Credit Association borrowers. Many of the FHA borrowers were young and inexperienced. This study, cooperative with Southern Illinois University, indicates some overlapping in the type of borrower served by the various lenders but that FHA operating loans are directed to a special segment of farmers.

9. The bulk of credit used in two depressed West Virginia counties in 1960-65 came from local commercial banks. These provided a stable supply compared to fluctuating amounts of credit received from other lenders, particularly those outside the counties. However, a few large business loans were made by institutional lenders from distant cities such as New York.

10. A study of the 1960 Census of Housing revealed that Federal Housing Administration and Veterans Administration insured loans were used less, and conventional loans more, in rural counties than in nonrural counties. Rural housing loans involved a higher proportion of local funds. Terms and characteristics of rural loans were generally less favorable to borrowers.

11. Analysis of data from 200 rural home buyers or builders in Missouri revealed that nearly three-fourths of the people who had bought homes without loans were 60 years old or older, and one-half had incomes of less than \$3,000 per year. The major comparisons were between homeowners who had acquired houses without credit, those who used a Farmers Home Administration (FHA-USDA) loan, and those who used credit other than from the FHA-USDA. More non-FHA-USDA credit users borrowed from commercial banks. However, if they were farmers, the Federal land bank was their main source of credit. Most of the FHA-USDA borrowers were 39 years old or older; their median annual family incomes ranged from \$5,000 to \$6,999. The FHA-USDA loans had interest rates of either 4 percent or 5 percent. Non-FHA-USDA housing loans ranged from 5 percent to 7 percent; the most common rate was 6 percent. Loan maturities ranged from less than 5 years for some commercial bank loans to 40 years for some FHA-USDA loans.

12. Analysis of data on demand and time deposits of country banks revealed that during 1967 such deposits continued an upward trend. The increase in country bank time deposits was greater in most regions of the Nation during 1967 than in 1966, although net farm income in 1967 was not quite as high as in 1966.

B. Farm Real Estate Values and Valuation

1. The market value of farm real estate per acre advanced 6 percent in the year ended March 1, 1968, raising the national index to 170 (1957-59 = 100). The 70-percent increase over the past decade represents an annual compound rate of 5.5 percent. For the latest 5-year period, the annual compound rate of increase was 6.6 percent. The total market value of farm real estate

reached \$194 billion on March 1, 1968, an average of \$69,000 per farm and \$178 per acre. If all farms are divided into two groups -- those with gross sales of less than \$2,500 and those with \$2,500 or more, the 1.6 million farms with sales of \$2,500 or more had an estimated market value of \$164.6 billion or \$100,400 per farm. The remaining group of smaller farms averaged \$24,200 per farm.

2. New estimates of the value of farm buildings show that buildings accounted for a declining proportion of the total value of farm real estate over the past two decades. Of the total increase of about \$72 billion in the market value of farmland and buildings, about \$65 billion or 90 percent was attributable to land and \$7 billion to buildings. As of March 1, 1968, the market value of farm buildings was estimated at \$35.9 billion or about 20 percent of total real estate value. Dwellings accounted for slightly more than half the value of all buildings.

3. Work continued on several aspects of share and cash rents for farm and rangelands. A weighted index of grazing fees per head per month was developed for the 11 Western States for 1958-68 for use by the Bureau of Land Management of the Department of the Interior and the Forest Service in revising their fee schedules. The average rate per head per month was found to be \$3.74 for 1968, up 18 percent from the 1958-59 average. Cash rents for farms rented wholly for cash were analyzed and related to prevailing market values of such farms. Gross rents in 1967 ranged from less than 4 percent of market values in the Northeast and Pacific regions to a high of more than 7 percent in the Southeast. Nationally, gross cash rent averaged 5.8 percent of value, and net rental return, after real estate taxes and other landlord's expenses, was 3.8 percent in 1967. Work is in progress to develop estimates of returns to land under prevailing share rental arrangements. Rental shares have been obtained for major crops in most counties of the country and a computer program has been developed to provide weighted rental shares for each crop, by States. Previous estimates had shown net land returns under share rental arrangements to be somewhat higher than under cash rent, chiefly because of the greater risks assumed by landlords. However, cash rents for cropland have become more prevalent in the Corn Belt and strong competition for land has established a level of \$35 to \$40 per acre for top-quality corn land.

Field studies of the land market were completed in Nebraska. A new study of land sales and rents is currently being developed in Oregon.

C. Economics of Farm Size and Number of Farms

1. Analysis of special tabulations from the 1964 census in which farms were classified according to the amount of hired labor showed that a high percentage of all farms are still organized predominantly as family businesses in which the operator and his family provide most of the labor. Family farms -- those hiring less than 1-½ man-years of hired labor -- accounted for 95 percent of all farms in 1964 and had 65 percent of the

gross sales of farm products. Self-employment accounted for three-fourths of total employment in farming nationally, but more than 80 percent of total employment in the North Central States. Farm production in California, Arizona, and Florida is associated chiefly with hired labor.

2. Census data for large-scale farms -- those having gross sales of \$100,000 or more -- were analyzed for 1959 and 1964. The number of such farms increased from 20,000 to more than 31,000 in 1964. Although they represent less than 1 percent of all farms, they accounted for about 25 percent of the total gross sales of farm products, compared with about 16 percent in 1959. California accounted for 23 percent of the total number of all large-scale farms and for 29 percent of the total sales of this group. Arizona and Florida also had substantial numbers of large-scale farms. In the Lake States and Corn Belt, large farms accounted for only 0.6 percent of all farms and for less than 10 percent of all farm sales.

With respect to commodities sold, 61 percent of the total sales of vegetables and 46 percent of the sales of fruits and nuts came from large-scale farms. Large-scale farms accounted for about one-third of the total sales of cattle and calves, but for less than 5 percent of the sales of hogs and pigs, tobacco, corn, soybeans and similar field crops.

3. Studies of the economics of farm size in Minnesota, California, Illinois, and North Carolina have been largely completed and publications are in process. A resurvey of a group of farms in North Carolina, previously surveyed in 1965, was conducted to obtain data for determining farm demand for labor and to obtain labor coefficients for the more common new technologies being developed in flue-cured tobacco areas. Information obtained in the survey included the number of farmers who entered or left the survey segments between 1965 and 1967, their previous and present occupation, where they came from and where they went, and the year of arrival or departure. Farm budgets have been developed for 6 tobacco production systems, including 2 with bulk curing and 4 using conventional barn curing.

Two manuscripts have been prepared from the California study of the economics of size in cotton and vegetable farming. One, "Risk and Uncertainty in Lettuce Production in the Salinas Valley," presents an analysis of the more common types of lettuce growing contracts with respect to financial equity under different price conditions. In the second manuscript, "Economic Problems of Sea Water Intrusion, Salinas Valley," welfare criteria were utilized to examine alternative methods of solving the problem of salt water entering the ground water reservoir in the vegetable producing area. It was found that a fresh water canal, financed partly by the urban areas and by the affected growers, would maximize the net social welfare of the northern part of the Valley. This paper has been accepted by the Journal of Natural Resources for publication.

4. Preliminary results from a Washington study of the economics of size of orchards indicate that production, costs, and price per box tend to increase

with acreage. The long-run average cost curves appear to be "U" shaped over the range programmed -- 10 to 80 acres. Production functions have also been developed for the 4 major apple producing counties.

D. Farm Labor Utilization and Productivity

1. The continuing research on labor requirements and use in farm production indicates that labor used on U. S. farms in 1967 reached a new low of about 7.4 billion man-hours, 1 percent less than in 1966. Labor devoted to the care of all crops rose slightly from a year earlier, and was higher in each crop group with the exception of sugar crops and cotton. Increases in acreage and production of wheat, corn, sorghum, and hay accounted for the greatest change. Work required for cotton continued to drop because of a decrease in acreage and an increase in mechanization. Labor used on live-stock dropped 4 percent from 1966 and reflects increased use of labor saving technology, particularly in the dairy industry where labor input dropped 8 percent from 1966.

Man-hours required for farmwork in 1967 increased in the Northern Plains, Southeast, Southern Plains, and Mountain regions. The greatest increase occurred in the Southeast, due chiefly to increased production of fruits and nuts and tobacco.

2. Benchmark estimates of man-hour requirements for fruits and tree nuts have been prepared by States for 1964. The weighted average amount of labor required per bearing acre of all fruits and tree nuts in 1964 was 100 man-hours. This is a decrease of 11 percent from the 1954 benchmark estimate. A manuscript presenting the 1964 State estimates of labor used for 28 fruits and tree nuts is being reviewed.

3. A manuscript, "Labor Input on Farms, 1964," presenting labor data from the 1964 Nationwide Pesticide Survey, is being reviewed. The average survey farm had a 1964 labor input of 5,650 hours. The labor input ranged from 3,819 hours for farms with annual sales of \$2,500 - \$4,999 to 72,417 hours for farms with sales of \$500,000 or more. Seventy-two percent of the labor input was furnished by the operator and unpaid family members. The farm operator alone contributed about one-half of the labor input. About two-thirds of the farms hired some labor in 1964. On those farms, hired labor constituted 39 percent of the total hours worked -- regular workers, 25 percent, and seasonal workers, 14 percent.

4. The continuing research on farm labor productivity and efficiency shows that farm output per man-hour in 1967 rose more than 6 percent from a year earlier. The increase in livestock production per man-hour was greater than for crops. The gain in labor productivity for livestock varied from 5 percent for meat animals to 10 percent for milk cows, while the increase among kinds of crops varied from less than 1 percent for sugar crops and fruits and nuts to 9 percent for feed grains. Food grains showed a moderate decrease. By regions, farm output per man-hour rose more than 12 percent

in the Northeast in 1967, while the increase was less than 1 percent in the Pacific region.

5. Fewer farmworkers in 1967 (4.9 million as compared to 5.2 million in 1966), in combination with greater quantities of most other production inputs, supplied food and other farm products to an increased domestic population. In addition, through exports, they supplied products to a large number of consumers in foreign countries. Total domestic and foreign consumers reached more than 42 per farmworker in 1967, or 2.9 more than in 1966. This was almost 20 more than a decade ago. The gain in persons supplied per farmworker has resulted from greater application of modern technology both on and off the farm, including the transfer of jobs from farmworkers to nonfarmworkers.

6. In a cooperative study with the Maine Experiment Station, work continued on the labor aspects associated with potato farming in Aroostook County. Farm budgets were prepared for alternative methods of producing potatoes. Representative small, medium, and large farms were synthesized. One situation envisioned traditional tillage practices, ownership of spray equipment, and conventional harvest methods. The other included more recent shifts to minimum tillage, custom aerial application of necessary sprays, and adoption of a mechanical harvester system. Equipment capabilities differed between farm sizes, with combinations reflecting typical purchases made by farmers. Investment requirements are close to \$1,000 per acre with slight advantages going to the medium and large size farms. Total unit-of-output costs were higher on model farms which used newer practices. With respect to cost advantages between the different sized farms, a medium sized farm growing 125 acres of potatoes had the lowest unit costs of close to \$2 per barrel. Cost savings were due primarily to combinations of equipment that were synthesized for this size farm. On a large farm growing 250 acres, however, unit costs were not significantly different from the medium sized farms. This analysis suggests that there are pressures to expand farm size from a typical size of 90 acres of potatoes. This does not take into consideration other factors, such as trends to centralized packing, which are exerting additional pressures in this direction.

7. In cooperation with the Michigan Experiment Station, a project to study demand for labor on Michigan fruit farms continued. Analysis of data obtained in a field enumerative survey of Michigan fruit farmers is continuing. Data on physical characteristics of the farms have been summarized. Aggregate farm production functions of the Cobb-Douglas type were fitted for those farms having 100 percent of their sales from fruit, using gross farm sales as the dependent variable and acres of fruit, machinery investment, family labor, and hired labor as independent variables. With this formulation, acres of fruit, machinery, and hired labor were found to be significant explanatory variables.

8. A cooperative study with the California Experiment Station on impact of labor-saving technology and scarcity of workers on an area's agriculture

continued. The major emphasis in the past year has been placed on the adjustment process of farm entrepreneurs. Analysis is based on data from a 1966 survey of 80 cash crop farms in the Sacramento canning tomato area. A complete set of data on land, labor use, crop acreages, yields, machinery and equipment investment, farm expenses, income, tenure arrangements, and adoption of new farm practices or innovations was obtained for 67 farms. Crop budgets and resource endowments have been constructed for a benchmark farm at each of four scales of operation. The analysis is essentially completed for the total study and is currently in first draft form.

9. A study of factors affecting the current and prospective demand for hired farm labor in Washington and Oregon, in cooperation with the Experiment Stations of both States, continued. Included is a study of mechanization in caneberry production, based on a survey following the 1967 harvest to provide data on mechanical harvesting as compared to conventional handpicking. The survey provided information on changes in plantings, labor skills required, and other factors, brought about by mechanization of the caneberry harvest. A report on this phase of the study has been delayed but will be prepared in the near future. Preliminary analysis of the data suggests that a substantial reduction in harvest labor requirements can be made through the use of mechanical equipment, and that there is a need for more highly skilled labor.

An initial draft of a report describing the major labor-intensive crops grown in the Pacific Northwest, labor requirements, and sources has been developed.

10. In cooperation with Purdue University, work continues on a project to investigate the impact of technological change on the demand for, and use of, farm labor with special reference to factor returns and to the labor skills needed in farming. Aggregate data for the United States for the period 1910 to 1966 were used to estimate national production functions and derived demand functions for farm labor. However, the Cobb-Douglas functions obtained do not seem appropriate since a substitution coefficient of 1.7 was obtained. Hence, further testing with other functional forms is planned before any results are released.

11. In cooperation with the Michigan, Wisconsin, and Minnesota Experiment Stations, a project to study labor and capital use in dairy farming in the Lake States continued. A mail survey was sent out to a stratified random sample of 1,250 dairy producers, each in Michigan, Minnesota, and Wisconsin. The population included all dairy producers in the State selling milk to creameries. Data on dairy technology, labor, assets and liabilities with other selected items in farms reporting milk sales were obtained from the 1964 pesticide survey schedule for all States. These data are now available and limited analysis was completed in fiscal 1967-68.

Using SRS data, preliminary projections of the number and size distribution of dairy farms were made for Minnesota. 1976 projections, assuming that

trends and conditions in the 1961-66 period continue in the future, indicate that 18,600 farms will leave dairying. Herds with 1-9 and 10-19 cows will decline rapidly, while the number of herds with more than 30 cows will increase sharply. By 1976 these larger herds will account for 58 percent of the cows in Minnesota. Projected 1976 milk production in Minnesota will be slightly less than 11 billion pounds. This amount is higher than 1967 production but slightly less than the 1964 record.

For Wisconsin, a manuscript entitled "Farm Size and Regular Hired Workers" is in process. Costs and returns data from the Wisconsin Farm Record Association indicated that about \$40,000 gross income was needed for a dairy farm to support one full-time worker. In 1967, only 1,800 farms in the sample had incomes over \$40,000 while there were 13,000 farms with full-time hired workers.

12. In cooperation with the Iowa Experiment Station a project has been initiated to analyze the demand and use of labor on Corn Belt livestock farms. The project is in the formulation stage. A survey schedule is being prepared for use in a survey of 100 specialized hog farms in the Corn Belt to obtain data on several hog production technologies and labor-capital substitution relationships.

E. Farm Mechanization and Selected Production Practices

1. Data on machine size by economic class of farm and type of farm are available from the 1964 National Pesticide Survey questionnaires. These data have been summarized by regions but need further quality checks before final analysis and publication.

2. For a national survey of machine use in 1965, the major results were summarized in last year's progress report. Additional material will be available from the 1966 Pesticide Survey questionnaires, mainly by economic class of farm and type of farm. Two reports are planned, one covering 1965 and one covering 1966.

3. Processing was completed on a 48-State survey on artificial drying or curing of crops and associated fuel use in 1966. A manuscript is ready to submit for clearance. In addition to results previously reported, total liquid petroleum fuel consumption amounted to more than 300 million gallons. This was over 100 million gallons more than were used to dry crops in 1953. Drying corn and curing tobacco in 1966 required nearly equal amounts (146 million and 143 million gallons, respectively), with 10 million gallons for peanuts. For drying soybeans, sorghum, and rice combined, 4 million gallons were used. An average of 5.6 pounds of tobacco was cured per gallon of fuel used and for peanuts, 45 pounds were dried per gallon of fuel.

4. Preliminary results show that liquid petroleum fuel continued to increase for household use, while the use of coal and wood decreased. From 1959 to 1966, household use of liquid petroleum fuel increased from 1,737 to 1,830

million gallons. The use of LP-gas for household purposes continued to increase from 44 percent of the total in 1959 to 51 percent in 1966.

5. Continuing research on principal machines on farms shows that with steady improvement in gross farm income from 1959 through 1966, and a relatively high level in 1967, farmers have improved their inventory of machines. At the same time, declines have occurred in the number of some machines, mainly because of obsolescence, fewer but larger farms, and substitution of larger machines. The number of automobiles on farms and the number of farms with milking machines started to decline sometime between 1954 and 1959. The number of grain combines and cornpickers appears to have peaked around 1959 or 1960. Numbers of wheel tractors, motortrucks, pickup balers, and field forage harvesters all increased between 1960 and 1968. The rise in numbers was greatest for motortrucks (300,000), but the percentage increase in pickup balers (16 percent) exceeded that for motortrucks (11 percent). The combined number of wheel and crawler tractors on farms increased about 40 percent from 1950 to 1968, but the horsepower available from them more than doubled in this time.

6. In February 1968, more than 25,000 questionnaires were received from 48 States on the extent of using various machines and equipment in harvesting the 1967 hay crop, along with labor used. The data are being processed.

F. Structure of Agriculture

1. "Structure of Six Farm Input Industries" is the title of a published report that presents a descriptive analysis of 6 selected industries -- petroleum, farm machinery and equipment, fertilizers, pesticides, livestock feeds, and farm credit. In 1966, farm production expenses totaled about \$33 billion, nearly half of which was spent for these six items. These leading inputs, mainly from the nonfarm sectors, provide the support for a rapidly developing commercial food and fiber industry. Not only are the volume and quality of the inputs themselves important, but also the management services that frequently accompany them. This report summarizes information about numbers, sizes, and other characteristics of business firms that supply farmers with these significant inputs.

No major industry has changed more than farming in the last quarter century. Farmers are continually adjusting to new technology, which has meant a significant shift from farm-produced to industry-produced inputs. The farm is now only one point in a series of production stages that begins with the farm input industries and goes on through further processing and transportation to the consumer.

2. A nationwide survey was completed in early 1968 to identify all corporations directly engaged in agricultural production. Preliminary results for 22 States showed that such corporations made up less than one percent of the total number of commercial farms in those States and accounted for about 4 percent of the total sales. More than 70 percent of the corporations found

were family businesses, most of which were family farms that had incorporated to facilitate transfer to surviving family members. About one-third of the corporations had one or more business activities in addition to their agricultural operations. In the Midwest, such activities frequently involved the manufacture or sale of feed, fertilizer and farm machinery, or the processing and marketing of farm products. The nonfarm business interests of about an equal proportion of farming corporations were not related to farm supplies or marketing.

About 40 percent of the corporations had gross sales of less than \$40,000, but nearly one-third had sales of \$100,000 or more and 6 percent had sales of \$500,000 or more. More than half of these largest incorporated farm businesses were family owned. Average acreages operated by corporation farms were 3 to 4 times the average acreage of all commercial farms in most States. Livestock operations on corporation farms were more frequent and on a substantially larger scale than for all farms in each of the operations. Typically, these were ranches or cattle feedlots, broiler, commercial egg, and turkey operations. Some of the crop enterprises involved vegetables and specialty crops such as cranberries, mint, and hops.

A preliminary report covering 22 States was published. Further analysis is being made of the characteristics of corporate farms for all 50 States, and a report is in process.

3. Field work on a study of feed purchasing practices of Illinois hog producers and the pricing and service policies of feed dealers was completed and analysis is underway. Prices paid for similar feeds were found to vary widely among farmers, depending upon the discount, credit and delivery policies of dealers. Discounts from quoted retail bag prices of as much as \$12 per ton were possible for farmers raising 1,000 hogs or more a year. Such discounts were obtained by large-volume purchases, advance commitments, and cash payment. The cost saving could amount to as much as \$1,000 on a hog enterprise of this size. The study will also examine other aspects of external economies of scale that may be available to the larger producer and will also appraise the extent to which the policies and practices of the feed industry serve as positive forces affecting the scale, geographic distribution and concentration of farm production.

4. In California, a study to project cropping patterns and land use neared completion. Work centered on delineation of homogeneous crop production areas, projection of urban development, and estimation of crop yields and costs. Some 121 crop production areas were delineated in the State based on soils and climatic conditions. Urban projections to 1980 were made for each production area. Acreage of orchard and vegetable crops not included in the study were estimated and projected to 1980. Cost and yield figures for crops in each production area were estimated and are currently being projected to 1980. It is anticipated that the methodology and results of the study will be written and submitted for publication during the coming year.

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GOVERNMENT PROGRAMS TO BALANCE FARM OUTPUT
(RPA 808)

USDA and Cooperative Program

Location of Intramural Work	Subject	Scientist	
		Man-years FY 1968	
Oklahoma	Production control	1.0	
Washington, D. C.	Production control	2.9	
Washington, D. C.	Production response	4.0	
		Total	7.9

Problems and Objectives

A chronic major problem in agriculture is to adjust production, both in the aggregate and for major commodities, to market outlets. Achievement of economic balance and adequate returns to farmers are likely to be difficult in the foreseeable future as we strive to match the increasing capacity to produce with current and prospective food and fiber requirements. Whereas individual farmers can adjust their businesses in various ways as discussed under Improved Livestock and Poultry Production Management Systems (RPA 313) and Individual Farm Adjustments and Management (RPA 316), when many farmers do this, total output mounts and the problem of balancing total supply with total demand is intensified. Government price support and production control programs are designed to help achieve balance, price stability, and income adequacy.

Major objectives of the research are to:

1. Evaluate the effectiveness of current and alternative control programs.
2. Appraise the effects of current and alternative programs on farm income, the distribution of farm income, farm production, and program costs.
3. Estimate probable future production response and resource adjustments to changes in programs in the context of changing technology, prices, costs, and other significant economic influences.

Progress - USDA and Cooperative Program

A. Economics of Production Control Programs

1. A study of minimum costs of retiring 50 and 70 million acres of cropland under a general cropland retirement program was completed and published. Costs would range from \$0.7 to \$1.2 billion per year. With an assumed maximum of 30 percent of the cropland that could be retired in any county, about 26 million acres of cropland in the Great Plains would be retired, if either 50 or 70 million acres were retired nationally. The remaining production potential even with 70 million acres retired would exceed 1967 production.
2. An analysis of secondary data to explain rates of participation in the Feed Grain Programs in Illinois revealed only a few factors correlated with participation; for some of these factors a rational hypothesis is lacking. For example, participation was positively associated with average corn yields in the previous year. A second stage of analysis included 13 factors which varied among counties but which were relatively constant through the time of analysis. Participation in the programs was found to be positively

correlated with the proportion of cash grain farms in a county, the proportion of cropland harvested as corn for grain, and the percentage of cropland not harvested in 1959. Variance in corn yield from year to year was negatively associated with participation. No significant relation was found between the percentage of farms participating in the Feed Grain Programs and the incidence of part-time or part-retirement farms, tenure status, educational level, place of residence of the operator, or other sociological factors. Results of the study were reported in a doctoral thesis.

3. The productivity of acreage diverted under Government programs in 1966 in 300 sample counties was analyzed. The study was based on SCS land use data by classes of land. The inherent productivity of diverted land is about 4 percent less than other land on the same farms; the range among 16 land resource regions was from 1 to 7 percent less for diverted land. The least difference was observed in the Lake States, and the greatest was in irrigated areas of the Southwest. A report of the findings is being prepared. Analysis is continuing to estimate the effect of geographical distribution of diverted land on potential aggregate production.

4. A survey was completed among about 175 Oklahoma farmers to learn their attitudes toward Government programs and alternative program provisions. Preliminary analysis of 73 questionnaires from Grant County indicates that these farmers place a high value on freedom to manage their resources but this value is tempered by a desire for security. Comparison with a similar survey in 1964 indicates that farmers' sentiment is moving away from free markets without Government controls. Alternatively, they favor voluntary diversion plans, farmer-run bargaining groups, and Government price supports. Except for minor shades of preference, attitudes did not differ among members of major farm organizations.

5. A study of the probable effects of payment limitations under Government programs is continuing with emphasis on the distribution by number, size, and source of payments, and the effects on farm organization and production and on program costs.

B. Appraisal of Production Response

1. A national programming model was updated and used to estimate 1968 production response under alternative Government program provisions for major crops. Results were not available until Fall 1967, after 1968 program provisions had been made by the Administration. The programming "dry run" nevertheless identified improvements needed in the model and in operating procedures. The model data were used to estimate the probable effects on production and diversion of different 1968 cotton program provisions. The data were also used in a preliminary analysis of a general cropland retirement program. Progress was made on updating and re-programming the national model for 1969, and restructuring it for analyses of response in 1970.

Although most of the work on this project has focused on the national programming model, increasing emphasis is now being placed on the development of a research "system," of which the programming model is but one component. This system, called the Aggregate Production Analysis System (APAS), is a means of expanding research capability by bringing to bear on policy issues a flexible combination of research techniques and informed judgment.

2. A study to develop a way of predicting the aggregate planted acreage of wheat in the Great Plains was completed. Among the variables considered, acreage allotments were found to be highly correlated with the acreage subsequently planted and therefore are a useful short-run predictor. A report was published.

3. A pilot analysis of production response on a representative farm in North Dakota showed that representative farm analyses can play a vital role in studies of aggregate production response even though a formal method of estimating aggregate production response remains to be developed. An internal working paper was prepared.

Publications - USDA and Cooperative Program

A. Economics of Production Control Programs

Vermeer, James and Slaughter, Rudie W., Jr. 1968. Analysis of a general cropland retirement program. ERS 377. 15 pp.

B. Appraisal of Production Response

Miller, Thomas A. 1968. The relationship of wheat planted to wheat allotments in the Great Plains. Agr. Econ. Res. 20(2), pp. 57-63.

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